IT QM Part1 Lecture 2

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Dr. Withalm Mar 3, 2009

IT QM Bratislava

Vorlesungen am Technikum-Wien Sommer 2007 (5B)

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02.03.2007	**Vorlesung 1 Bedeutung der Qualität, Qualitätsbegriff und Normen**
07.03.2007	**Vorlesung 2 Von der Qualitätsprüfung zur Qualitätssicherung**
21.03.2007	**Vorlesung 3 Meilenstein des Qualitätswesens-Arbeitsorganisation**
23.03.2007	**Vorlesung 4 Qualitätskosten-Führungsverhalten 1**
30.03.2007	**Vorlesung 5 Führungsverhalten 2- Q-Awards**

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Lectures at the University of Bratislava/Spring 2009

12.02.2009	**Lecture 1 Impact of Quality-From Quality Control to Quality Assurance**
05.03.2009	**Lecture 2 Organization Theories-Customer satisfaction-Quality Costs**
12.03.2009	**Lecture 3 Leadership-Quality Awards**
26.03.2009	**Lecture 4 Creativity-The long Way to CMMI level 4**
02.04.2009	**Lecture 5 System Engineering Method-Quality Related Procedures**
16.04.2009	**Lecture 6 Quality of SW products**
23.04.2009	**Lecture 7 Quality of SW organization**

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Lectures at the University of Bratislava/Spring 2007

19.02.2007	**Lecture 1 Impact of Quality-From Quality Control to Quality Assurance**
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19.03.2007	**Lecture 3 Leadership-Quality Awards**
02.04.2007	**Lecture 4 Creativity-The long Way to CMMI level 4**
16.04.2007	**Lecture 5 System Engineering Method-Quality Related Procedures**
30.04.2007	**Lecture 6 Quality of SW products**
07.05.2007	**Lecture 7 Quality of SW organization**

Vorlesungen am Technikum-Wien Sommer 2008 (5A/5B)

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04.03.2008	**Lecture 1 Impact of Quality-Quality Definition-Standards**
11.03.2008	**Lecture 2 From Quality Control to Quality Assurance**
01.04.2008	**Lecture 3 Organization Theories-Product Liability-Emphasis from Quality Control to Prevention**
08.04.2008	**Lecture 4 Customer Satisfaction-Quality Costs**
15.04.2008	**Lecture 5 Team Work-Leadership Behavior-Deal with Changes-Kind of Influencing Control-Conflict**
27.05.2008	**Lecture 6 Tasks &Responsibility of Leading Personnel-Audits-Quality Awards**
10.06.2008	**Lecture 7 Management Science-Creativity Techniques-Embedded Systems-FMEA**

Today's Agenda

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- From Quality Control to Quality Assurance
- From Quality Assurance to Quality Management

Conclusion of Part 1/1

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- Impact of Quality
  - Quality wins
  - Quality deficiencies
- Standards
  - Quality definition
- Evolution from quality control to TQM
  - Shewhart, Deming, Juran, Feigenbaum, Nolan, Crosby, Ishikawa
- Evolution of organization theory
  - i.e. Taylorism, System Dynamics, System Thinking, Quality Assurance
- Product liability
- Customer satisfaction
  - Criteria, two-dimension queries, inquiry methods

Conclusion of Part 1/2

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- Quality costs
  - Failure prevention, appraisal, failure, conformity, quality related losses, barriers
- Leadership
  - Behavior, deal with changes, kinds of influencing control, conflict resolution, syndromes to overcome when introducing changes
- Audits
- Quality awards
- Creativity techniques
  - Mind Mapping, Progressive Abstraction, Morphological Box, Method 635, Synectics, Buzzword Analysis, Bionic, De Bono
- Embedded Systems
- FMEA-Failure Mode Effect Analysis

From quality control to quality assurance/1 W.A.Shewhart/1.

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Evolution of control

Little control	beginning of control	parts fitted together	inter-change-ability
1 mio	300.000 BC	8000 BC	1787

Exact	Go	Go- Nogo	Quality control chart
1787	1840	1870	1924

From Quality Control to Quality Assurance/2
W.A.Shewhart/1

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W.A.Shewhart developed the quality control chart.

Walter Andrew Shewhart *(March 18, 1891 - March 11, 1967) was a physicist, engineer and statistician, sometimes known as the father of statistical quality control*

In his book "Statistical Method from the Viewpoint of Quality Control" he describes three steps of quality control

specification, production (provision of accomplishment) and inspection."

From quality control to quality assurance/3 W.A.Shewhart/2.

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Starting point:

Replaceability of products was 1787 for the first time requested

i.e. attempts were undertaken to accomplish the exact dimensions of the specifications (without any tolerances)

But practical experience shows:

It‘ s impossible to produce absolute identical parts also when efforts are extremely increased.

From quality control to quality assurance/4 W.A.Shewhart/3.

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Question:

Does raising of efforts make sense or are other approaches more appropriate ?

Solution:

These considerations lead to the introduction of values which enabled the producer to decide if product may be produced within the tolerances (Go)

But:

Nevertheless practitioner aim for exact values.

From quality control to quality assurance/5
Control Chart/1

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Example: Production of a cylinder

- Take into account values for accepting products
- What are the impacts on workers .

Perception:

Definition of windows to decide if produced products lie inside or fall outside the tolerances

(Go and Nogo conditions)
For each target value:
Declare upper and lower limit for tolerances

From quality control to quality assurance/6 Control Chart/2.

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Impact:

Transition from exact designed values to tolerance windows implies the advancement from deterministic school of thought to the probabilistic one.

Confession that we are to an certain extent dependent on accident.

From quality control to quality assurance/7 Control Chart/3

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Consequences :

Theory of probability gains in importance:

Investigation of new possibilities to reduce nonconforming units

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Search after methodologies to reduce efforts for testing

From quality control to quality assurance/8 Control Chart/4.

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Important factors on the way to quality assurance

- advancement from deterministic school of thought to the probabilistic one

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- rapid development of standards

From quality control to quality assurance/9
Control Chart/5

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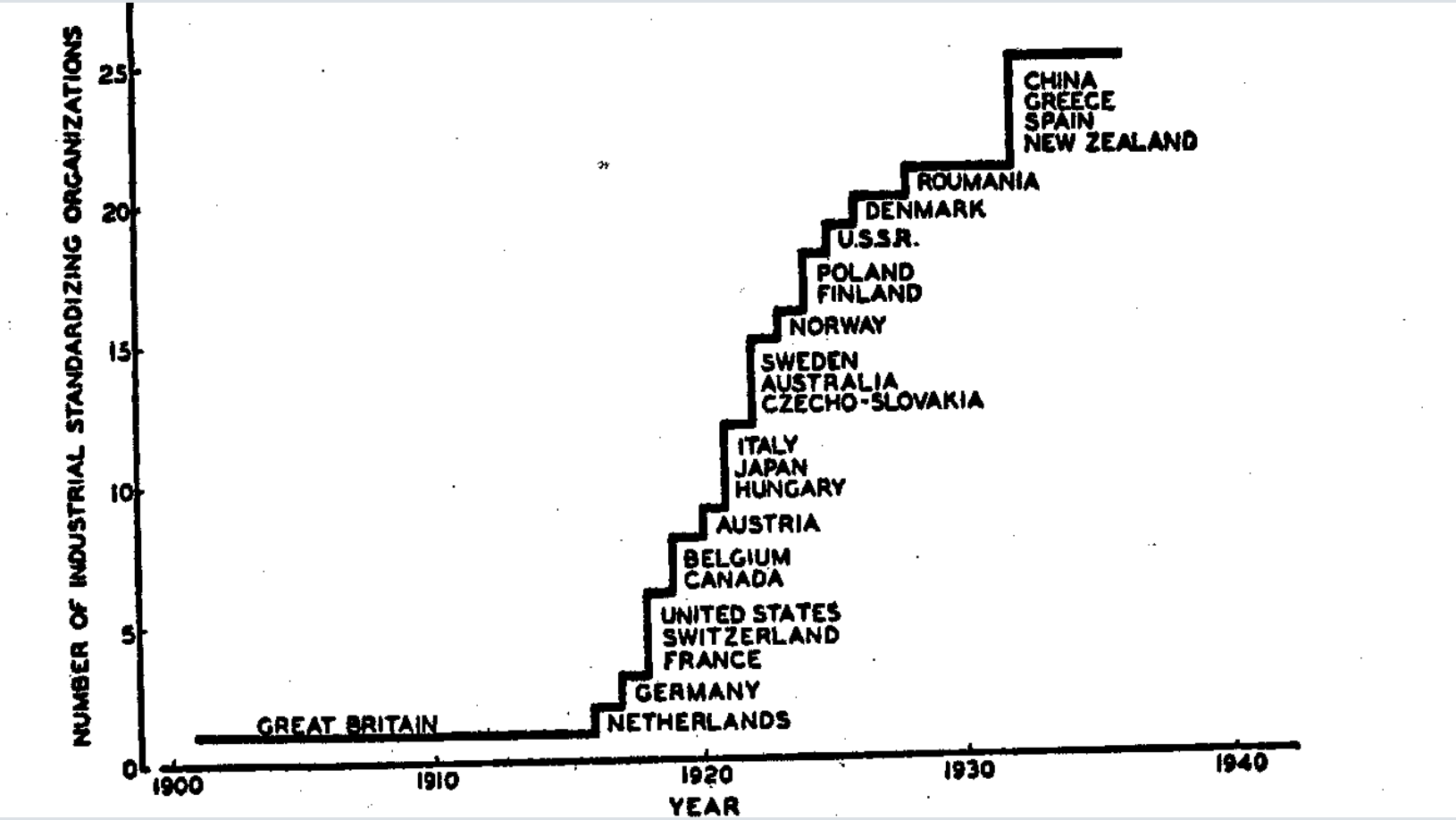
Standardization: Emerging of Standardization institutes



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Definitions according to Shewart:

quality control

state at which specified values are within specified tolerances.

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statistical quality control

By means of statistical methods you detect whether the process observed is under control

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process- design:

If you design a process you expect reproducible products within a bandwidth

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The process designer tries

- to design the process where results may be planned
  - forecast how often an expected product will lay within specified bandwidths.

- variability should be reduced on an economic meaningful degree.

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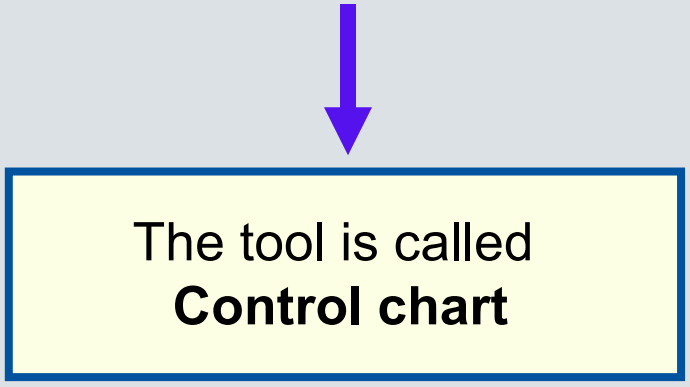
Tools for the process designer:

- Forecasting method with minimal error
- a means to minimize the variability at producing a product at given costs



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Definition of control chart:

- **The control chart, also known as the 'Shewhart chart' or 'process-behaviour chart' is a statistical tool intended to assess the nature of variation in a process and to facilitate forecasting and management**

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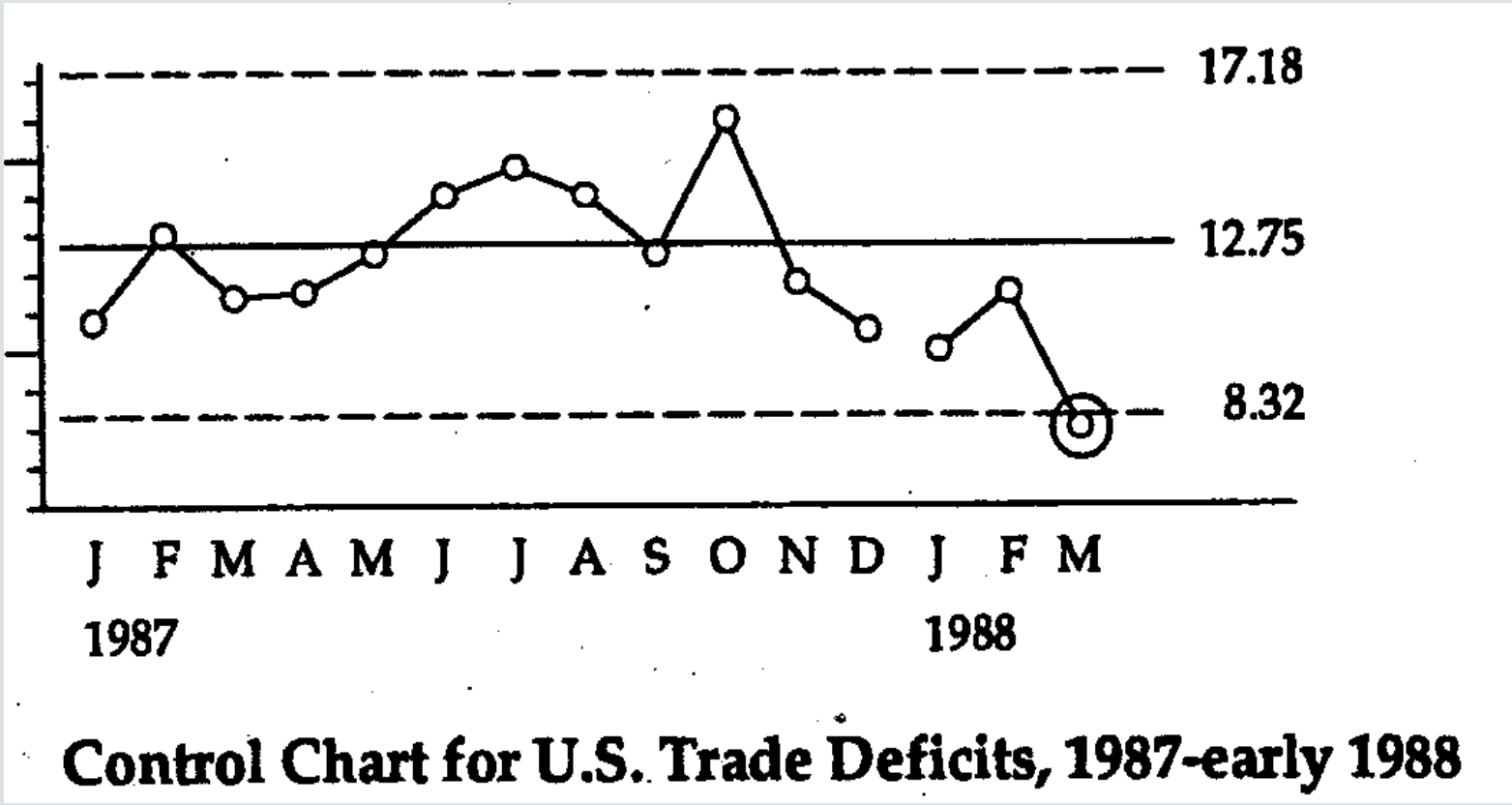
Control Chart:



Control Chart for U.S. Trade Deficits, 1987-early 1988

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Composition of a control chart

1. A centre line, drawn at the process mean;
2. An upper control-limit (also called an upper natural process-limit drawn three standard deviations above the centre line; and
3. A lower control-limit (also called a lower natural process-limit drawn three standard deviations below the centre line

How to proceed:

- Render data points about the timeline.
- Calculate the mean value
- Calculate the standard deviation
- Render mean value
- Render two parallels to the mean at intervals of $+3\sigma$ and -3σ

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Shewhart set *3-sigma* limits on the following basis

- The coarse result of Chebyshev's inequality that, for any probability distribution, the probability of an outcome greater than k standard deviations from the mean is at most $1/k^2$.
- The finer result of the Vysochanskii-Petunin inequality , that for any unimodal probability distribution, the probability of an outcome greater than k standard deviations from the mean is at most $5/9k^2$.
- The empirical investigation of sundry probability distributions that at least 99% of observations occurred within three standard deviations of the mean.

From quality control to quality assurance/17
Control Chart/13

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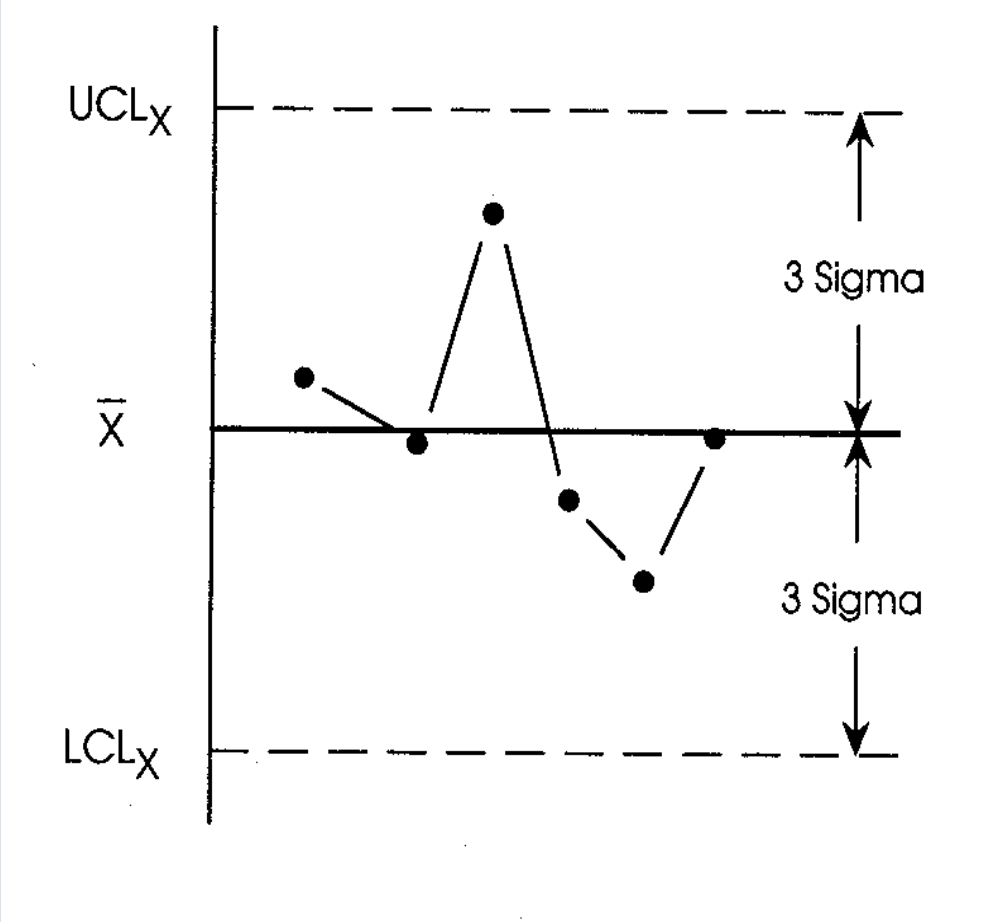

From quality control to quality assurance/18 Control Chart/14.

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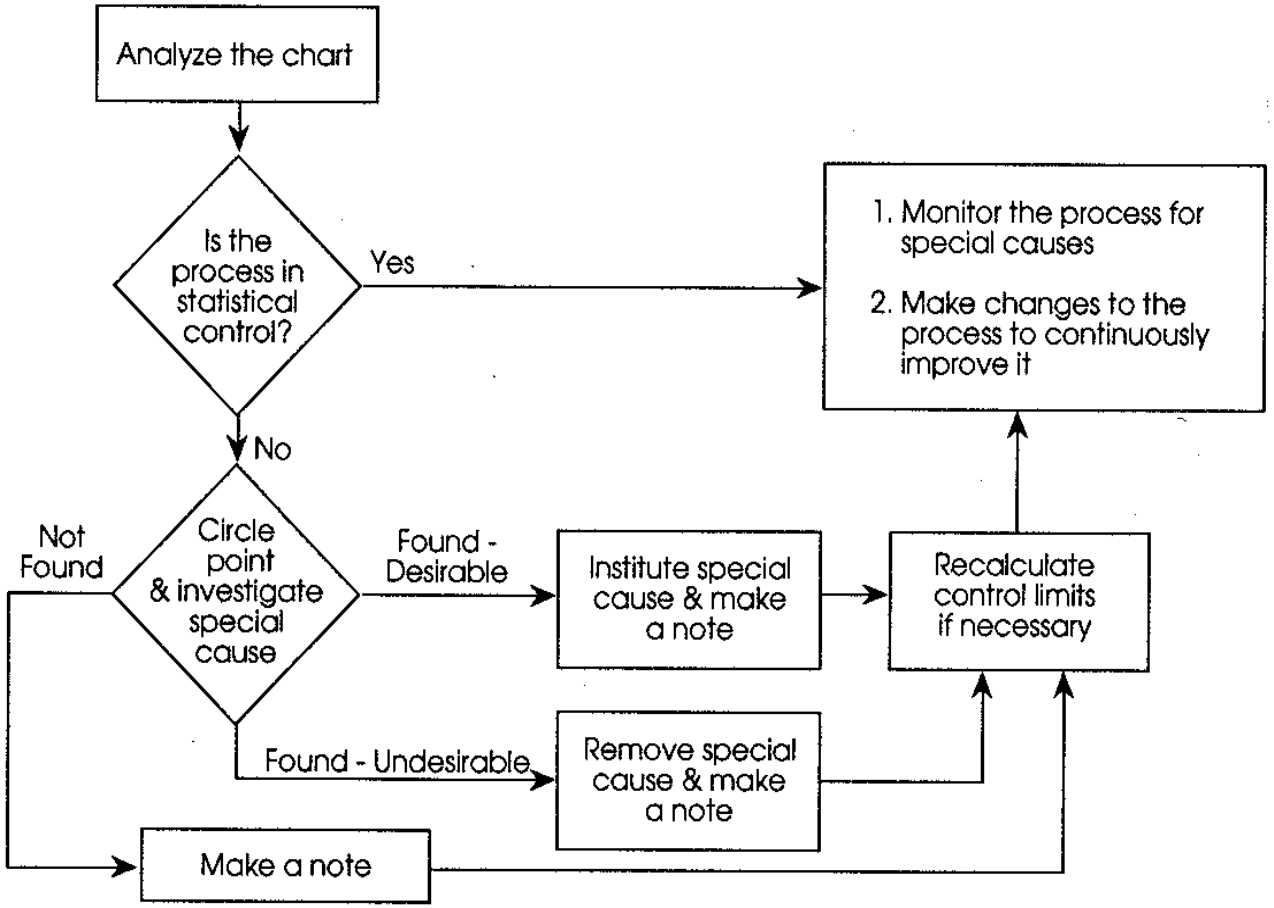

From quality control to quality assurance/19 Control Chart/15.

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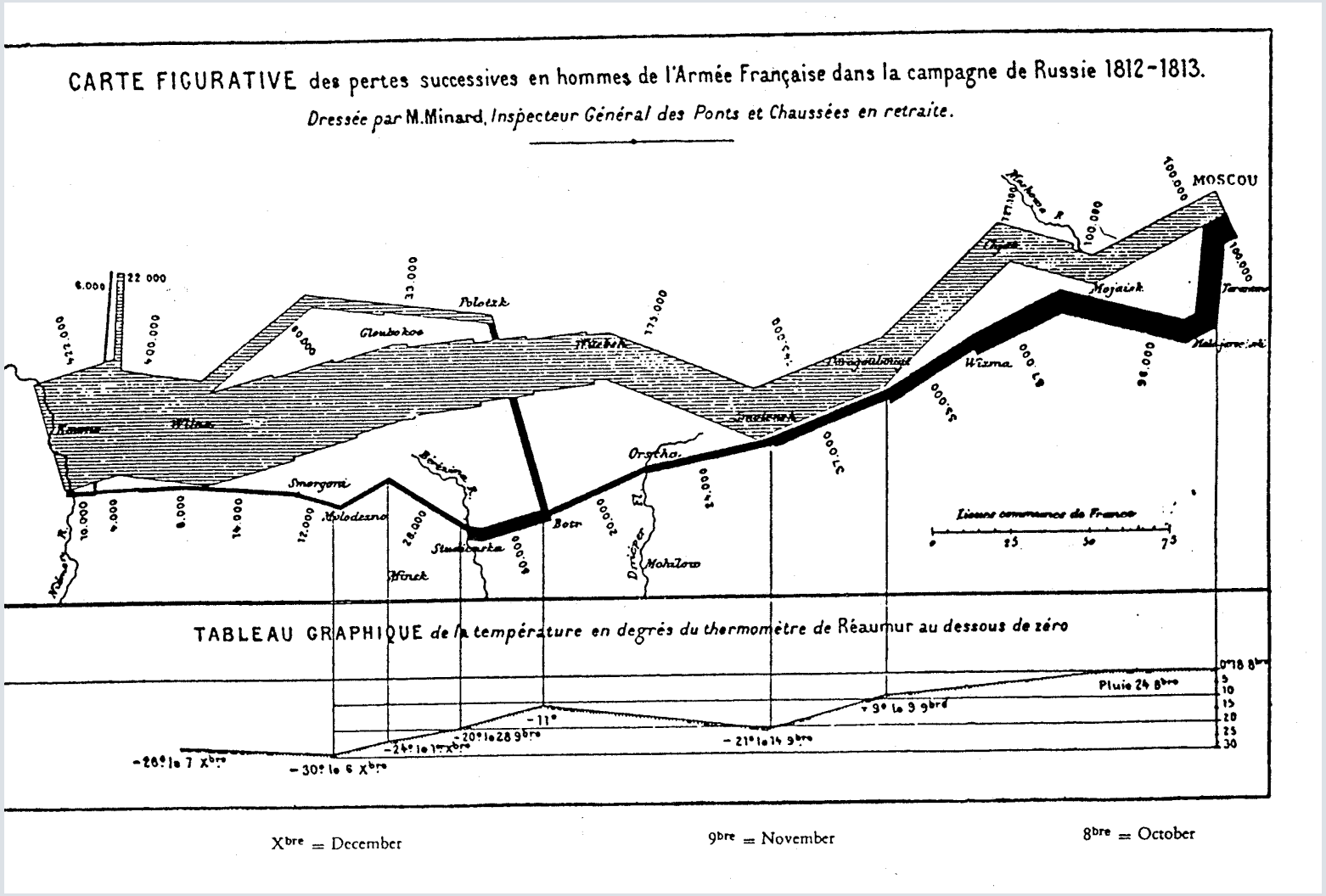

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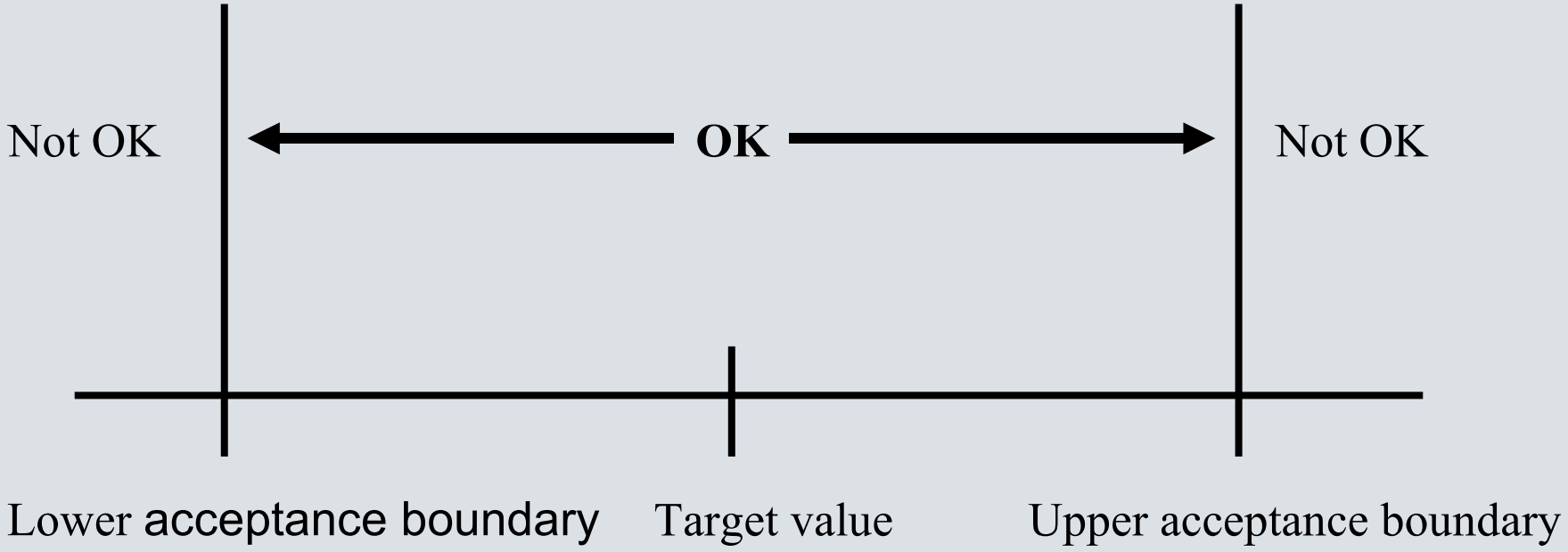
Deviation:

Deviation: not adherence of requirements



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statistical spread – the concept of Shewart

Controlled statistical spread

A steady Controlled statistical spread

Not controlled statistical spread

Inconsistent and stochastic statistical spread

From quality control to quality assurance/21 fundamental terms of statistics/1

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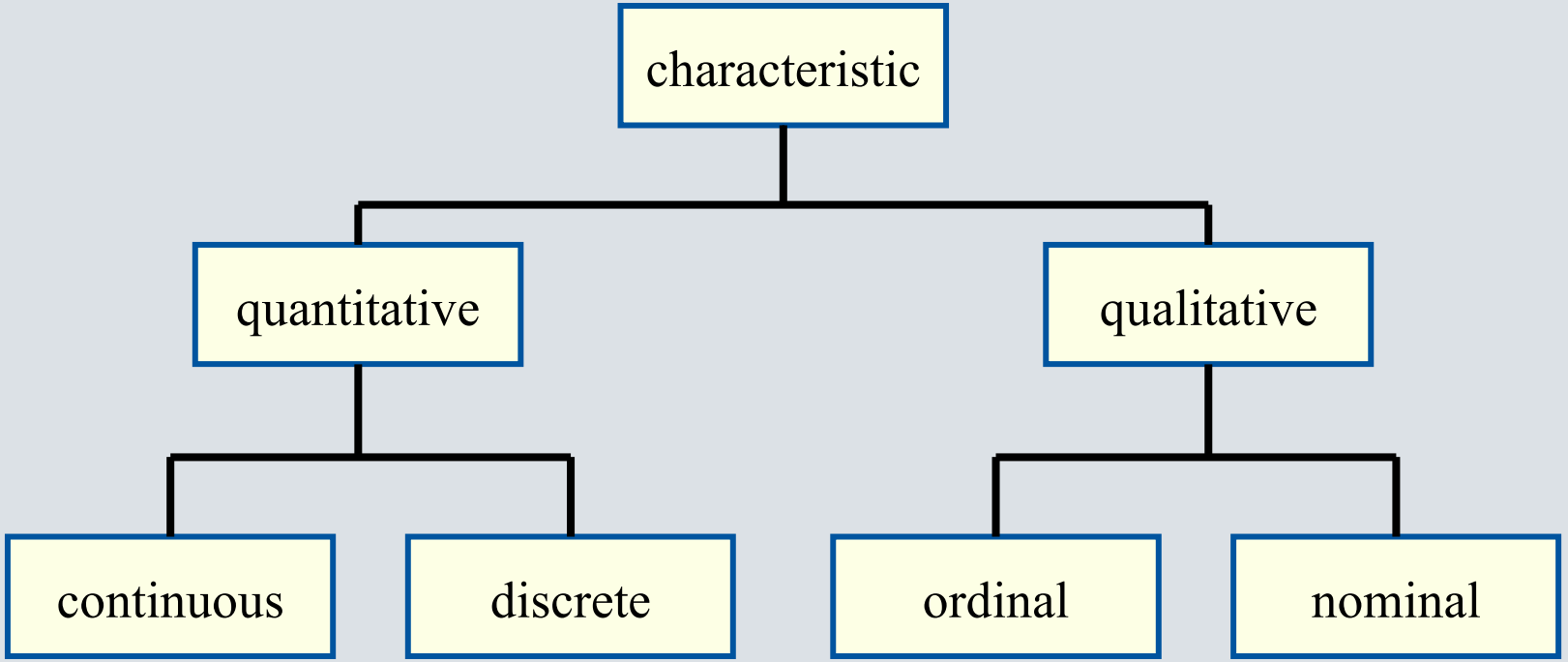

Weight	Population figure	School grade	Gender
length	Sum of the pips on the dice	hardness grade	color

From quality control to quality assurance/22 fundamental terms of statistics/2

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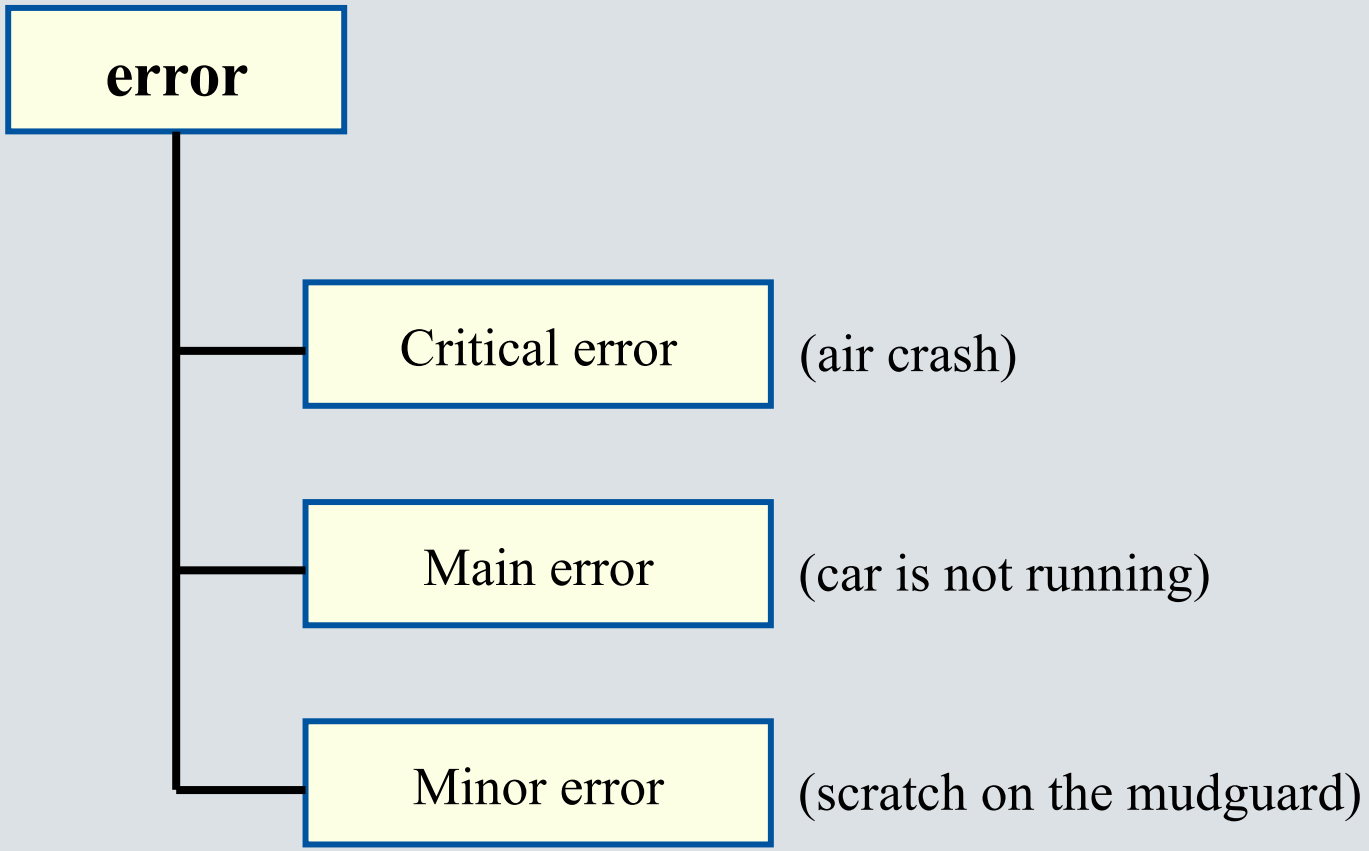

From quality control to quality assurance/23 fundamental terms of statistics/3

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- **Mean**:In general, given *n* numbers, their arithmetic mean is computed by the formula

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i .$$

- **Standard deviation** of this population is defined as

$$\sigma = \sqrt{\frac{1}{N} \sum_{i=1}^{N} (x_i - \bar{x})^2}$$

From quality control to quality assurance/24 fundamental terms of statistics/4

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Range

$$R = x_{max} - x_{min}$$

acceptance boundaries

Upper acceptance boundary

$$UCL_x = \bar{x} + 3\ s$$

Lower acceptance boundary

$$LCL_x = \bar{x} - 3\ s$$

From quality control to quality assurance/25 fundamental terms of statistics/5

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Original data for usage of a control chart

13,5	12,5	14,3	11,1	12,7
14,9	14,8	14,7	14,6	14,5
14,4	13,4	13,5	11,1	14,1
12,8	12,3	13,5	12,3	13,0

Mean values for usage of a control chart

13,9	13,3	14,0	12,3	13,6

From quality control to quality assurance/26 fundamental terms of statistics/6

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From quality control to quality assurance/27 fundamental terms of statistics/7

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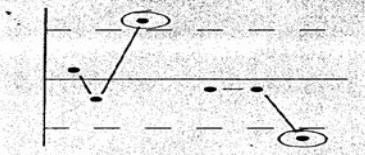
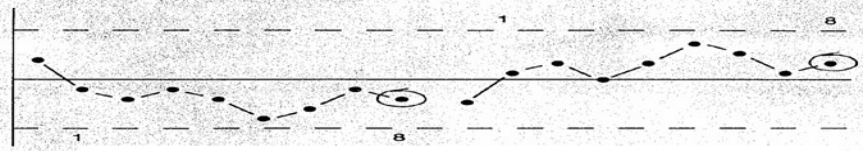
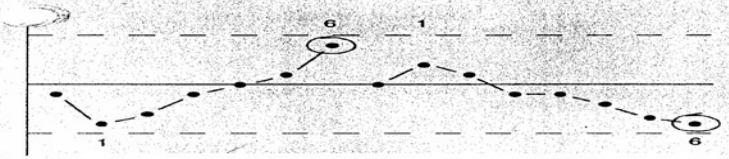
Observation of special causes

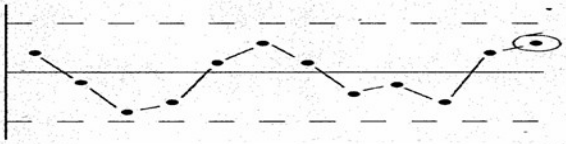


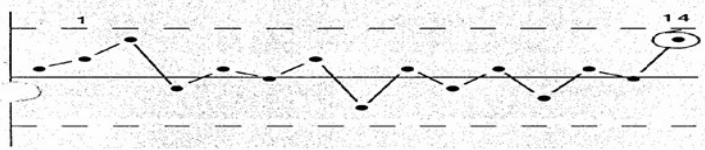
one point outside the borders

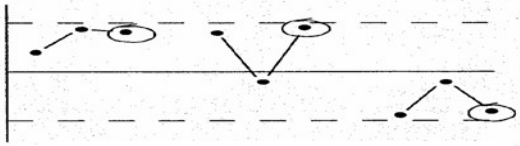


eight successive scores upper or below the average value

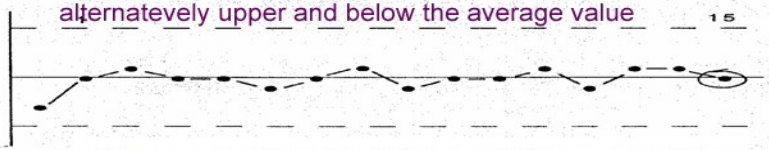




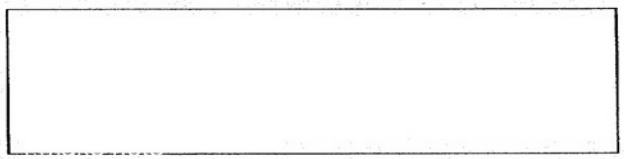




fourteen follow-confining one on the other scores alternatevely upper and below the average value



fifteen one on the other follow-confining scores within a sigma



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Steps to reach the statistical quality control

- Ascertain
  - How to collect data
  - Control criteria
  - Measures at deviations
  - Required data to control the process statistically

From quality control to quality assurance/29 fundamental terms of statistics/9

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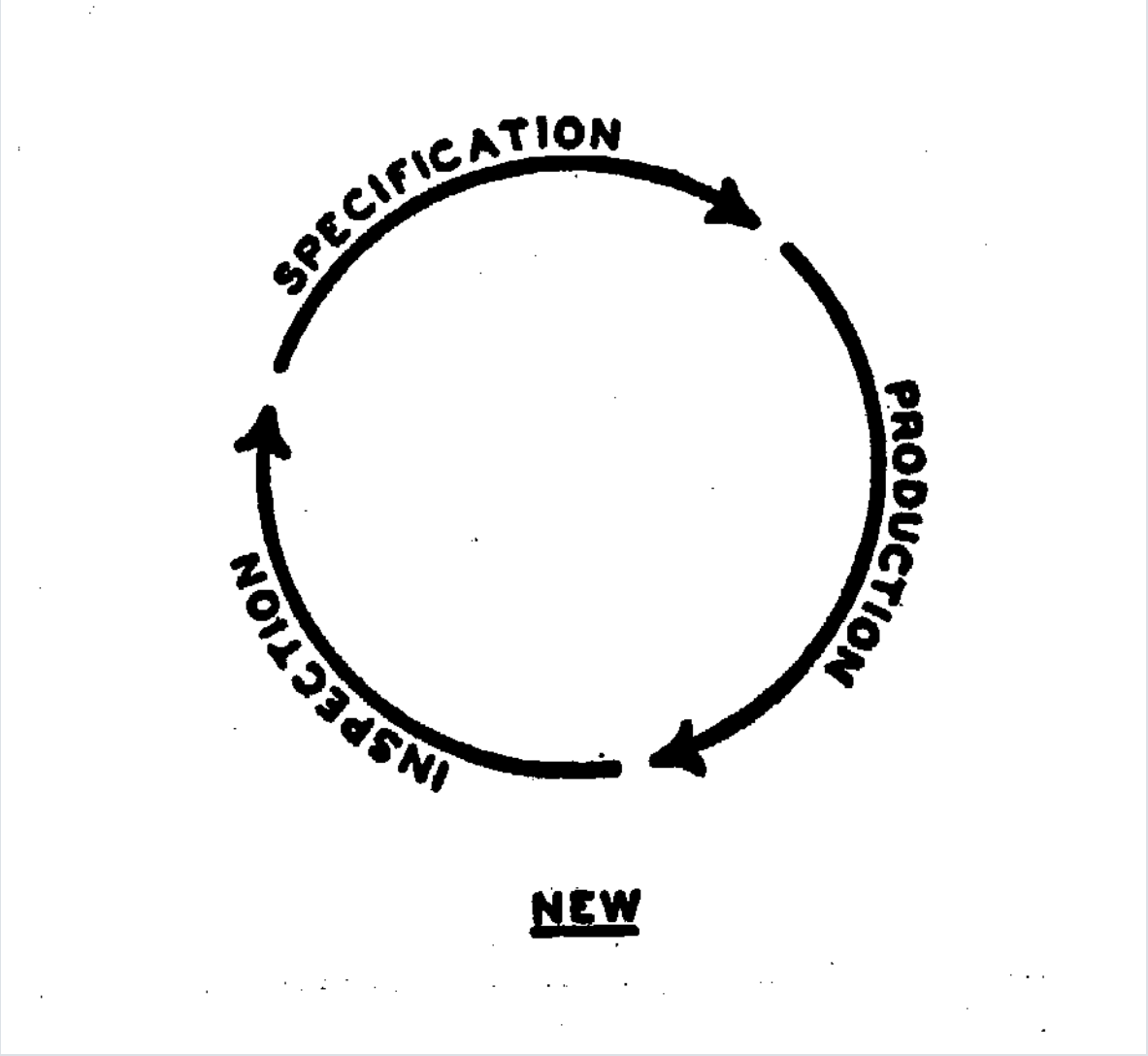
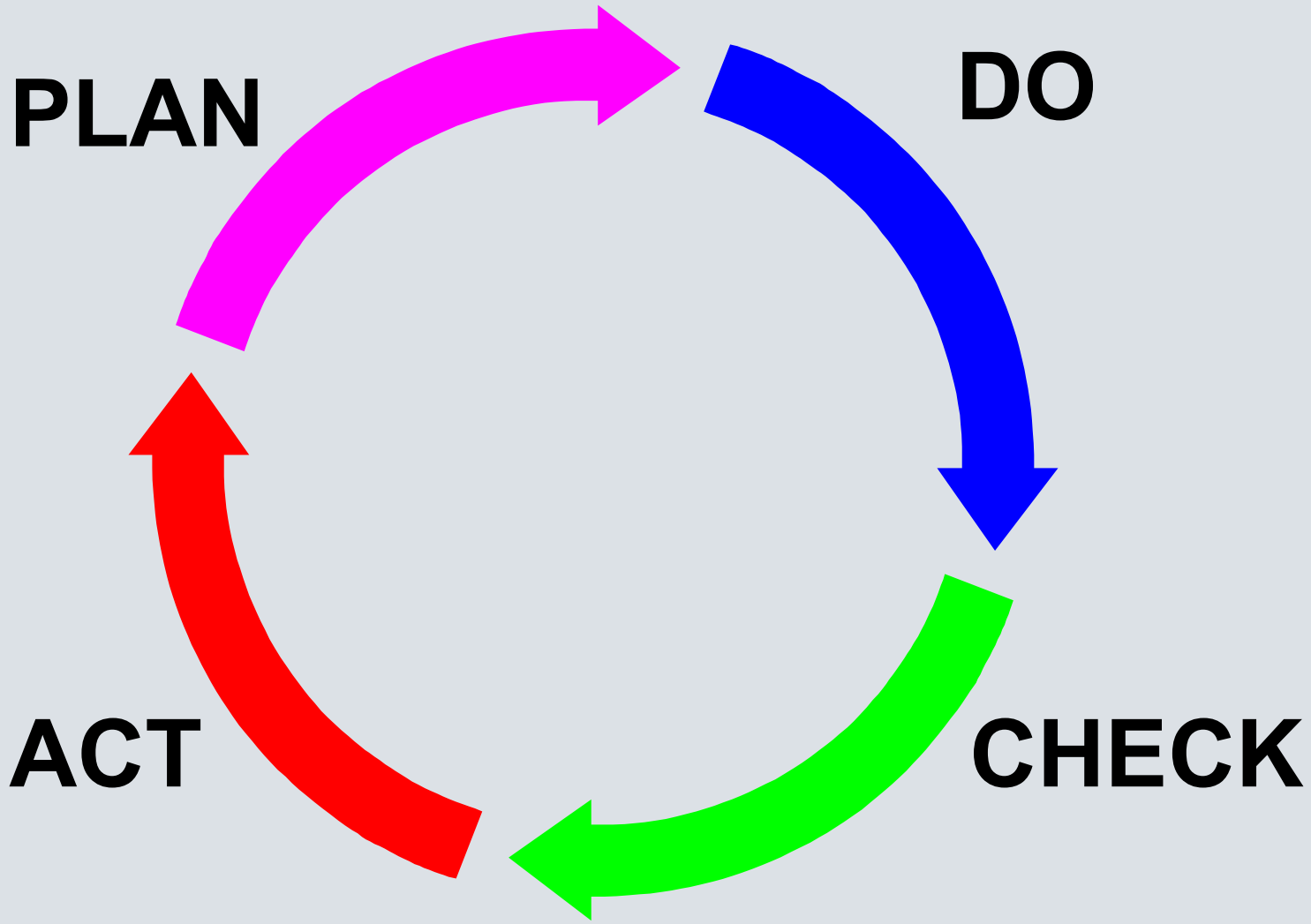


From quality assurance to quality management/1



From quality assurance to quality management/2

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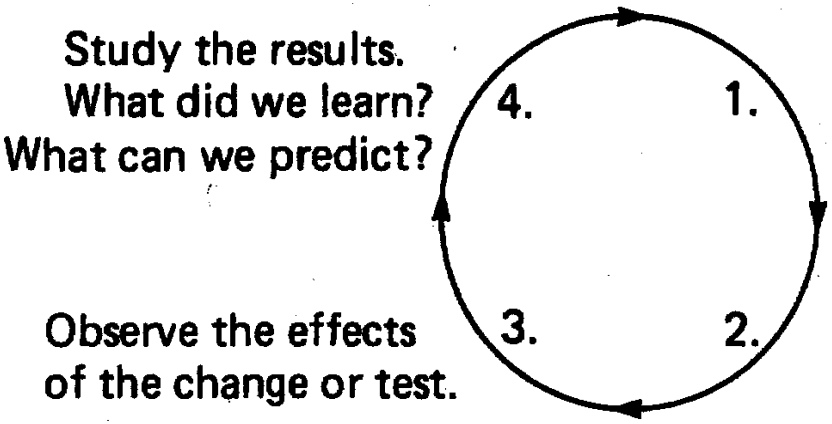

Step 5. Repeat Step 1, with knowledge accumulated.

Step 6. Repeat Step 2, and onward.

From quality assurance to quality management/3

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Second World War; USA:

Second World War: application in the arms industry

After Second World War; USA:

- USA
  - sole nation with efficient infrastructure

  - Producing products for the whole world
    - Monopoly position because of the war
  - Otherwise no willingness to deal with methods
    - For increasing the efficiency

From quality assurance to quality management/4

After Second World War; Japan :

- insular state with high population density
- infrastructure destroyed by Second World War
- devasting impact of two atomic explosions

Ideal medium to learn and apply management methods of USA.

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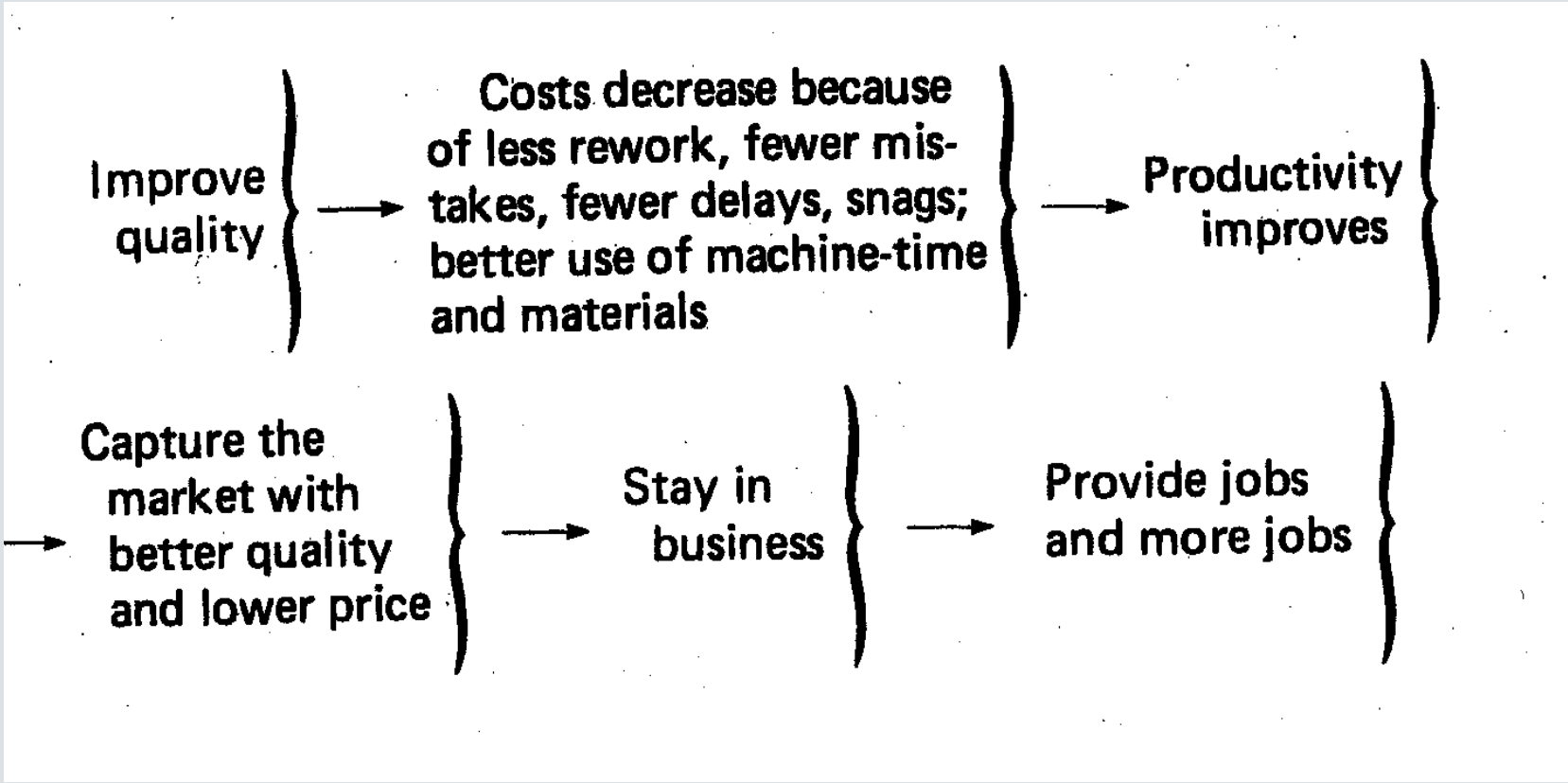
Deming-Chain-Reaction



From quality assurance to quality management/5

Demings 14 Points/1

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- A transformation is necessary to transcend an organization
  - Basing on Taylorism
- To the level of quality assurance.

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Deming‘s 14 points are a forerunner of total quality management.

From quality assurance to quality management/6
Demings 14 Points/2

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Transformation is not:

One time project work

with defined starting and final conditions measured on achievement criteria

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Transformation is:

Cultural change

As prerequisite for further operative changes

From quality assurance to quality management/7
Demings 14 Points/3

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Create constancy of purpose toward improvement of product and service, with the aim to become competitive and stay in business and to provide jobs.

Adopt a new philosophy. We are in a new economic age. Western management must awaken to the challenge, just learn responsibilities, and take on leadership for change.

Cease dependence on inspection to achieve quality. Eliminate the need for inspection on mass basis by building into the product in the first place.

From quality assurance to quality management/8
Demings 14 Points/4

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End the practice of awarding business of price tag. Instead minimize total cost. Move toward a single supplier for any item, on a long-term relationship of loyalty and trust.

Improve constantly and forever the systems of production and service, to improve quality and productivity and thus constantly decrease costs.

Institute training on the job.

From quality assurance to quality management/9
Demings 14 Points/5

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Institute leadership. The aim of leadership should be to help people and machines and gadgets to do a better job. Leadership of management is in need of overhaul, as well as leadership of production workers.

Drive out fear, so that everyone may work effectively for the company.

Break down barriers between departments. People in research, design, sales and production must work as a team, to forsee problems of production and in use that may be encountered with the product or service.

From quality assurance to quality management/10
Demings 14 Points/6

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Eliminate slogans, exhortations and targets for the work force asking for zero defects and new levels of productivity.

Eliminate work standards (quotas) on the factory floor. Subsitute leadership. Eliminate management by objective. Eliminate management by numbers, numerical goals. Substitute leadership.

Remove barriers that rob the hourly worker of his right to pride of workmanship. The responsibility of supervisors must be changed from sheer numbers to quality. Remove barriers that rob people in management and in engineering of their right to pride of workmanship.

From quality assurance to quality management/11
Demings 14 Points/7

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Institute a vigorous program of education and self-improvement.

Put everybody in the company to work to accomplish the transformation. The transformation is everybody´s job.

From quality assurance to quality management/12
Demings 14 Points/8

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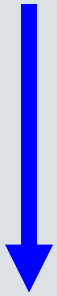
Relevance to

Involve top management

For the successful introduction of statistical methods



Management is responsible for the general conditions under which processes and activities are performed.

From quality assurance to quality management/13
System of profound knowledge/1

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- Deming's theories are summarized in his two books,
  - Out of the Crisis and
  - The New Economics,
    - in which he spells out his "**System** of **Profound Knowledge**"

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Paradoxon of system design:

The more comprehensive and/or complex a state of affair is the less will be designed/planned

From quality assurance to quality management/15
System of profound knowledge/3

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- **Planning** is the management function that is concerned with defining goals for future organizational performance and deciding on the tasks and resources needed to be used in order to attain the said goals. To meet the goals, managers will invest significant resources for training and incentives to motivate employees
- A **system** typically consists of components (or elements) which interface in order to facilitate the 'flow' of information, matter or energy. The term is often used to describe a set of entities which 'act' on each other, and for which a mathematical model or a logical model may be constructed encompassing the elements and their allowed actions

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Four components:

- Appreciation of a system
- Knowledge about variation
- Theory of Knowledge
- Psychology

From quality assurance to quality management/17
System of profound knowledge/5

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Policy Deployment

From quality assurance to quality management/18
System of profound knowledge/6

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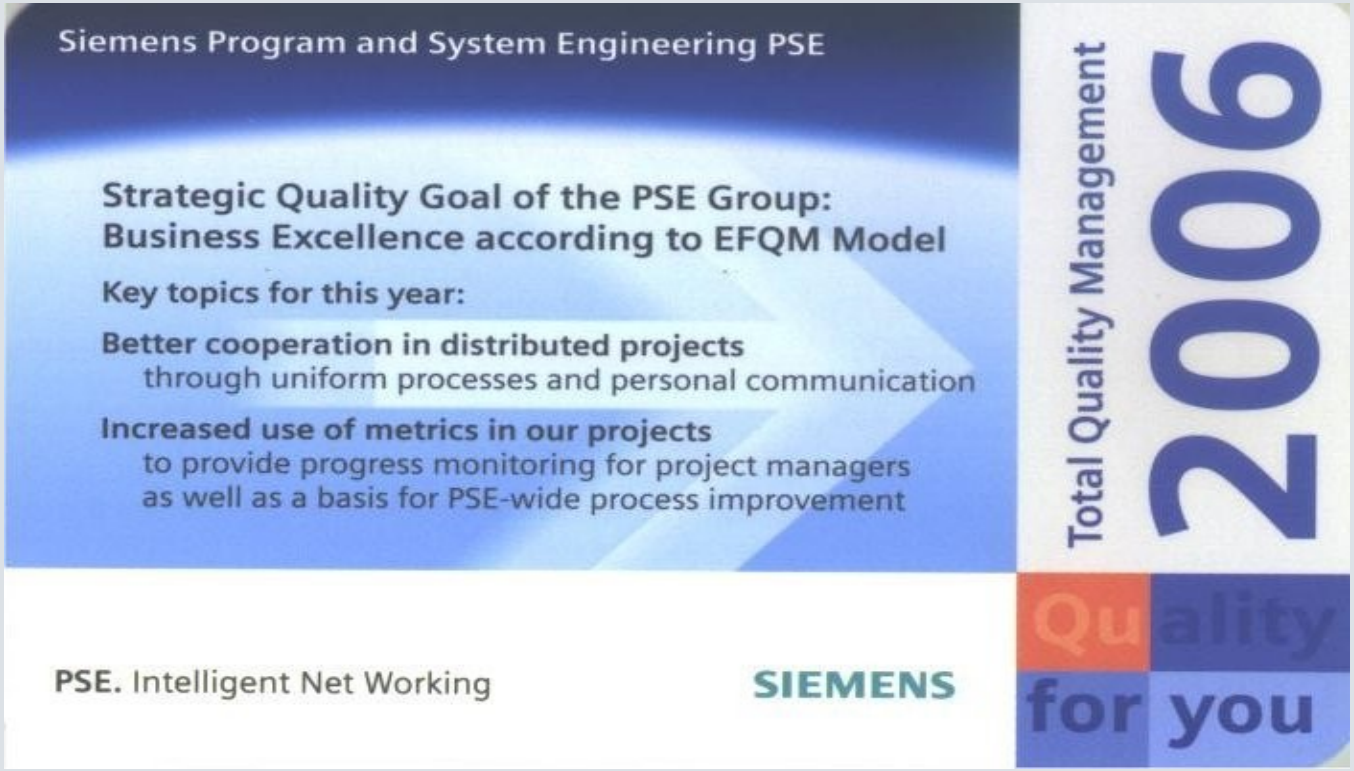
- Example from Siemens



From quality assurance to quality management/19
System of profound knowledge/7

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- **Outstanding quality is vital for our success.**
- **Quality is personal**
- Quality is the **responsibility of each employee**. We all share the responsibility for our quality, with each of us making an active contribution to the quality of our products and services with his or her work.
- **Quality is mandatory**
- Reaching and maintaining high quality standards requires their permanent application and improvement in all our products and services. Quality must become **a matter of course in our day-to-day work**.
- **Quality is all-encompassing**
- It pertains to **all divisions** of the company and is relevant for **all aspects**of our work. We all are called upon to boost the success of our company by showing individual creativity and personal commitment to the cause.

From quality assurance to quality management/20
System of profound knowledge/8

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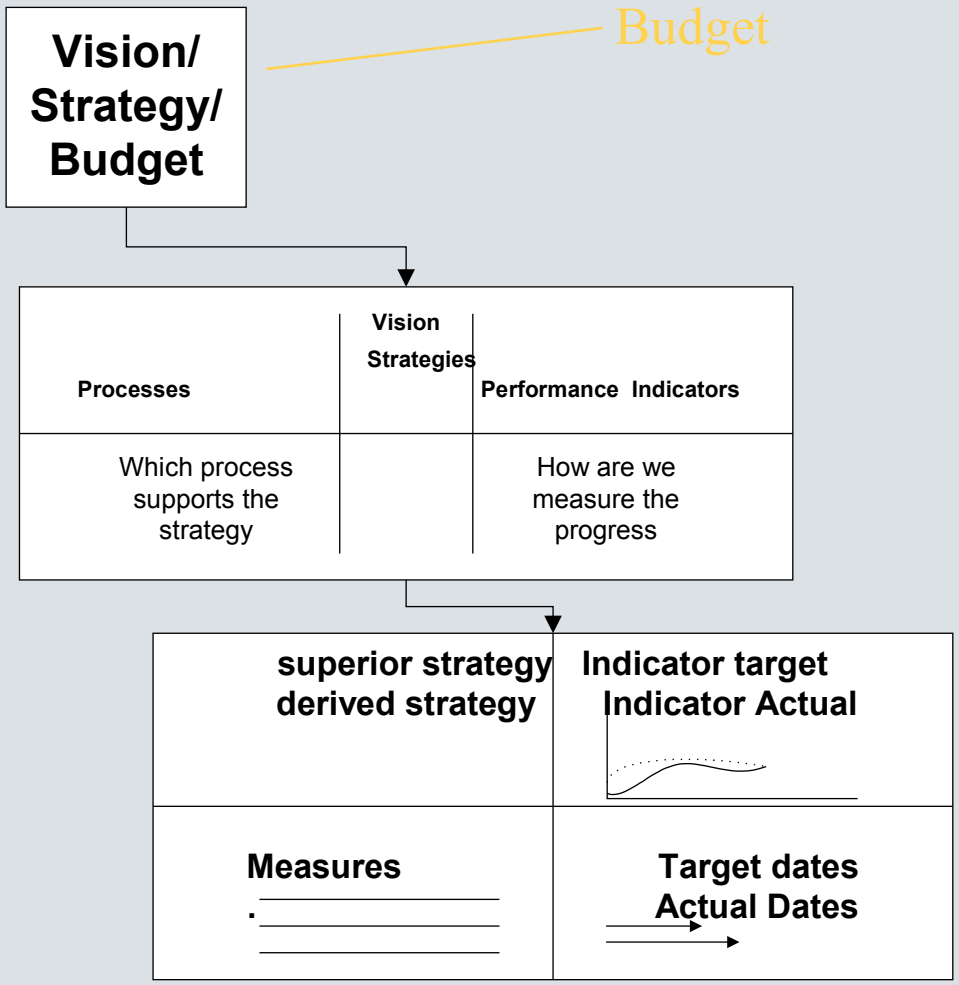

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Knowledge about Variation

Difference:Determinism-Probability

Why is the knowledge about variation so important for a group/company?

- Analyzing of situations
- Making decisions

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Tools to identify/analyze problems

Identify Problems	As well as	Analyze Problems
flowchart	Paretodiagramm	Histogram
Test arc-tally sheet	Cause/impact diagram	Disperse diagram
Brainstorming	Characteristic diagram	Control chart
Nominal group technique	lamination	Process capacity
		Strength area

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Tools to work with ideas

Work with Ideas	*Work with Numbers*
Flow Chart	Test arc-tally sheet
Brainstorming	Paretodiagramm
Nominal group technique	Characteristic diagram
Cause/impact diagrams	lamination
Strength area	Histogram
	Disperse diagram
	Control chart
	Process capacity

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Application of „systems of profound knowledge“

Counterpoint to Taylorism:

Laborer who is unskilled and focused is displaced by a generalist..

The Generalist

- knows multi disciplinary contexts
- Introduces within an organization appropriate methods
- Trains colleagues to apply these methods
- Not necessary to be expert in one of the four components of the system of profound knowledge

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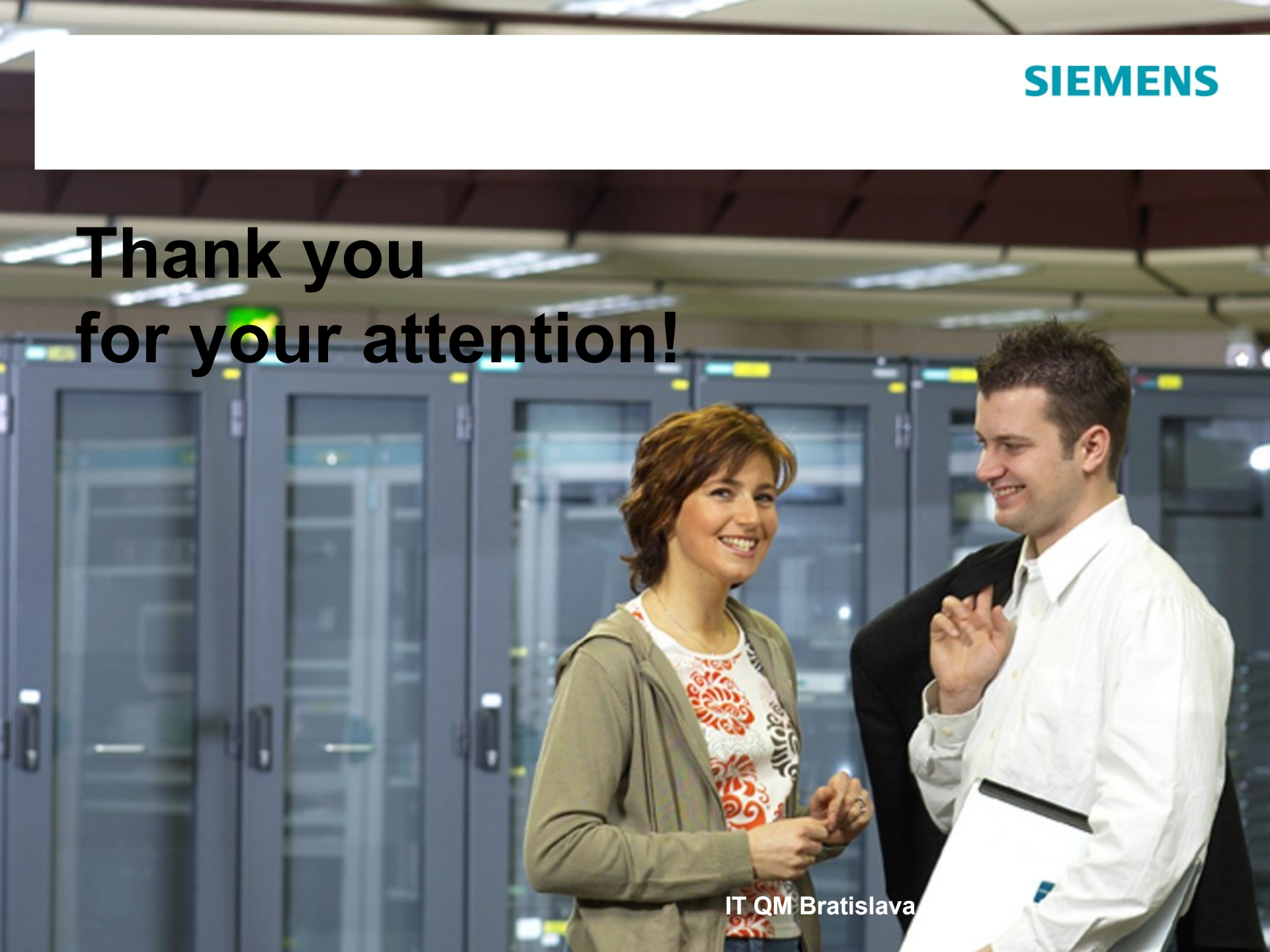
Thank you for your attention!



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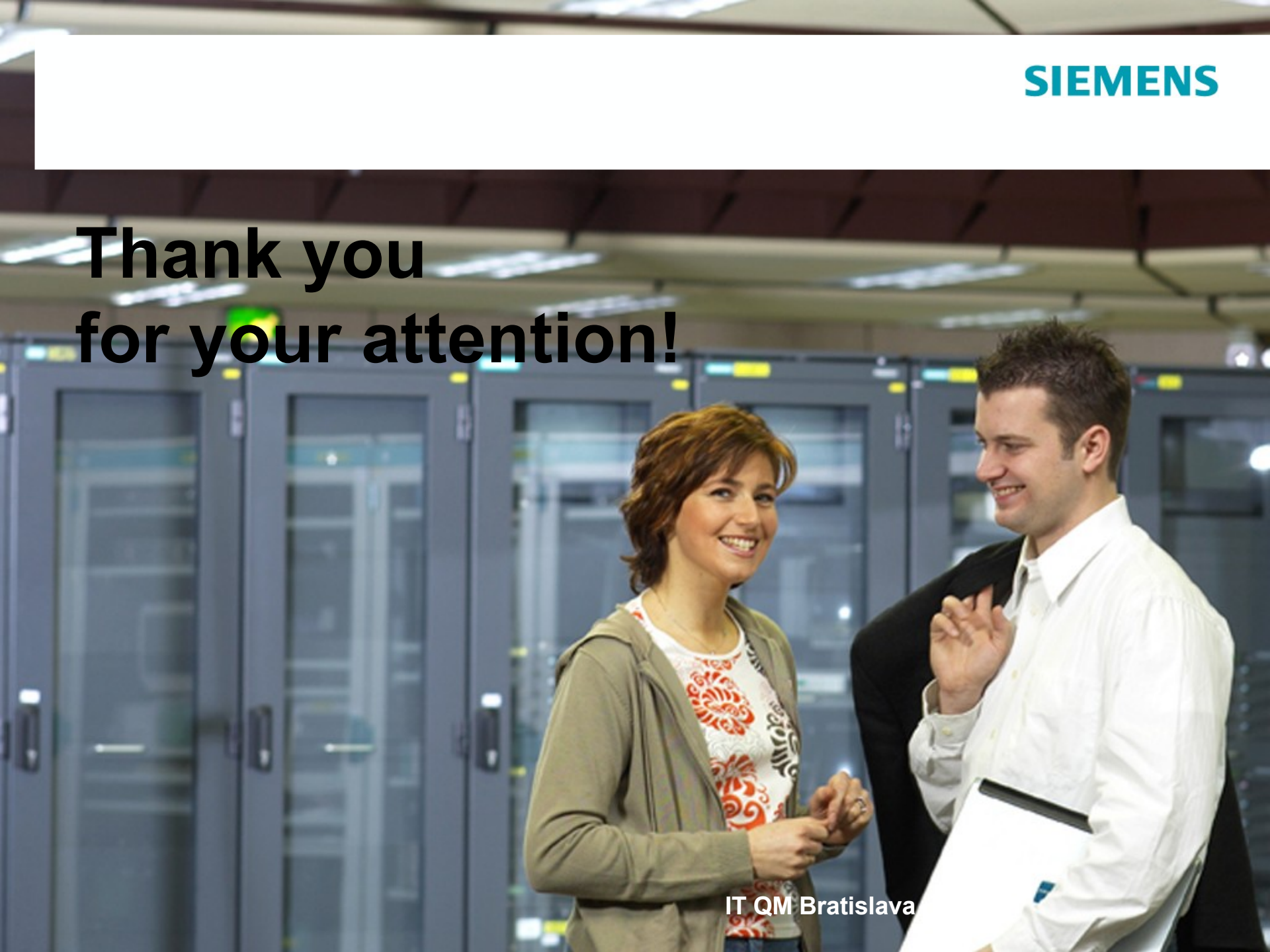
Thank you for your attention!



Farbpalette mit Farbcodes

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Primäre Flächenfarbe:

R 255 G 255 B 255

Sekundäre Flächenfarben:

R 215 G 225 B 225	R 170 G 190 B 195	R 130 G 160 B 165
R 220 G 225 B 230	R 185 G 195 B 205	R 145 G 155 B 165

Akzentfarben:

R 255 G 210 B 078	R 245 G 128 B 039	R 229 G 025 B 055	R 000 G 133 B 062	R 000 G 084 B 159	R 000 G 000 B 000
R 255 G 221 B 122	R 248 G 160 B 093	R 236 G 083 B 105	R 064 G 164 B 110	R 064 G 127 B 183	R 064 G 064 B 064
R 255 G 232 B 166	R 250 G 191 B 147	R 242 G 140 B 155	R 127 G 194 B 158	R 127 G 169 B 207	R 127 G 127 B 127
R 255 G 244 B 211	R 252 G 223 B 201	R 248 G 197 B 205	R 191 G 224 B 207	R 191 G 212 B 231	R 191 G 191 B 191
R 255 G 250 B 237	R 254 G 242 B 233	R 252 G 232 B 235	R 229 G 243 B 235	R 229 G 238 B 245	R 229 G 229 B 229