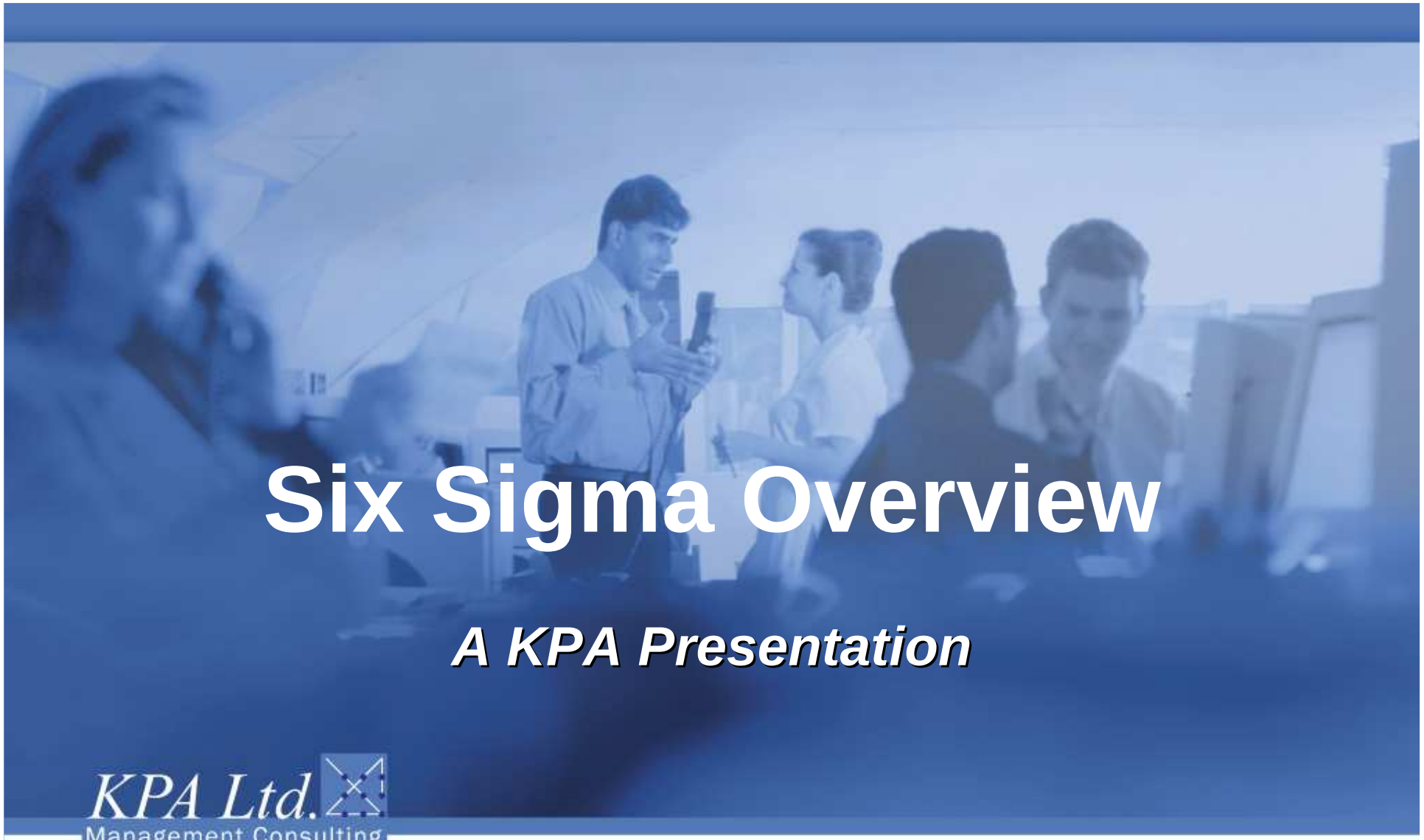

# Six Sigma Overview

***A KPA Presentation***

KPA Ltd.
Management Consulting

*sixsigma@kpa.co.il*

# *KPA Ltd.*
# Management Consulting

- ***KPA*** is an international management consulting firm with offices in Israel and strategic partners in the US, Spain, Belgium, France and Central Europe. Formed in 1990 by Professor Ron Kenett as a partnership, the firm incorporated in 1994.
- The ***KPA*** staff consists of specialized consultants with expertise in strategic planning, market research, industrial statistics, quality and risk management, business development and human resource management. ***KPA*** is currently involved in the strategic planning of medium and large companies, in international market research and customer surveys, establishing quality systems and Six Sigma initiatives, organizational development, risk management and change management consulting.

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# The KPA Vision and Mission Statement

## Our Mission

"To provide our customers with the expertise required to formulate strategies, concepts and breakthrough business processes that will turn their organizations into leaders in their field."

## Our Vision

"To be known as a center of excellence in modern management methodologies and as a source of research and training in our field."

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# KPA areas of activity


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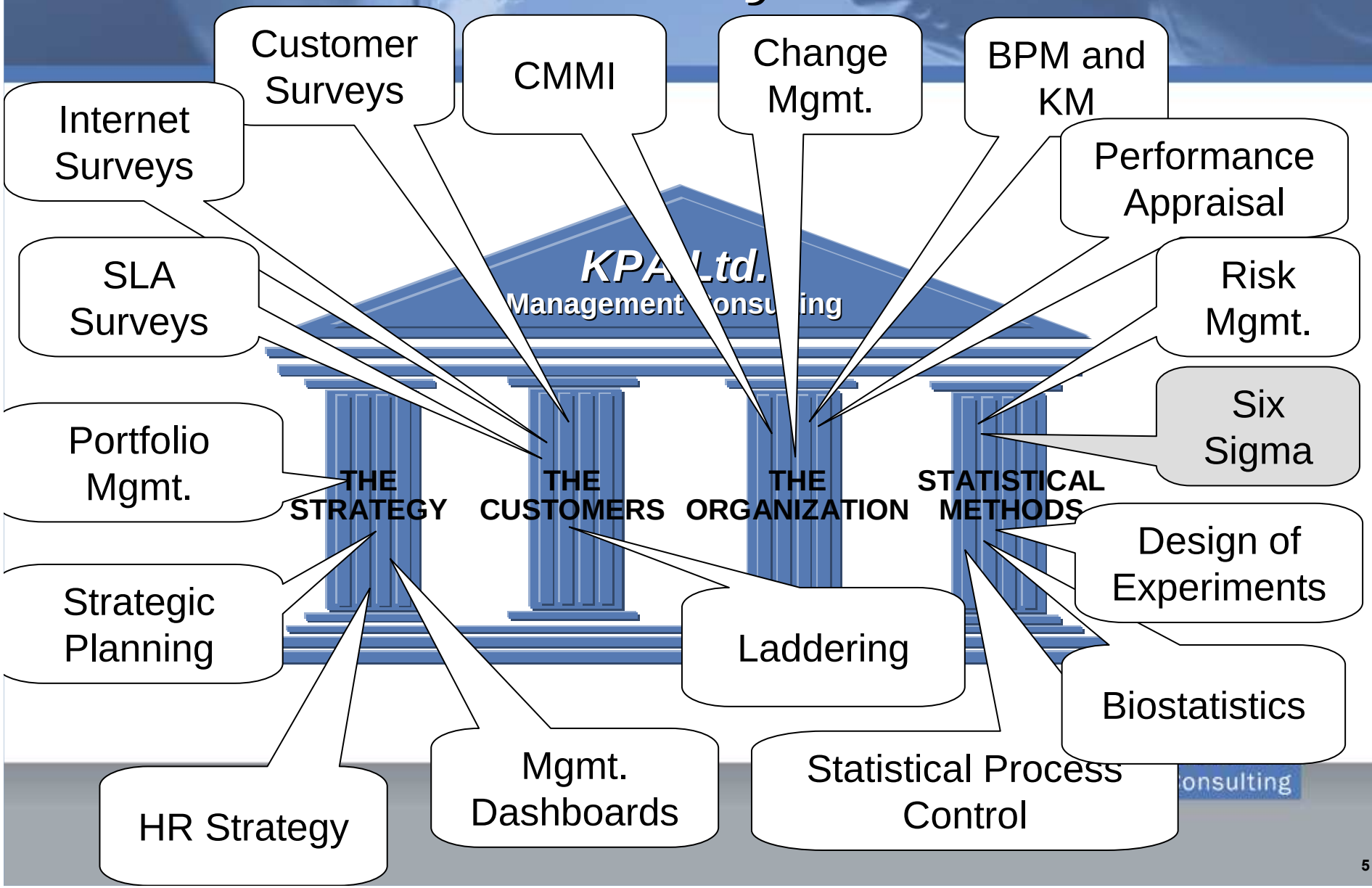
# KPA areas of activity



# *KPA* products and services

- Strategic Planning, Change Management, Six Sigma initiatives, joint ventures and M&A facilitation
- Market Research and Voice of the Customer Surveys
- Organizational Development, Appraisal Systems and Voice of the Workforce Surveys
- Statistical Consulting, Data Mining, Risk Management, Industrial Statistics, Biostatistics
- **Six Sigma training and consulting**

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# *KPA* clients' industrial areas

- Telecommunications
- Software
- Banking
- Plastics
- Chemicals
- Pharmaceuticals
- Food & Beverage
- Electronics
- Cellular Services
- Health Care
- Education
- Energy
- Transportation









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# *KPA* - partial clients list

- The Israel Electricity Corporation, utility
- The Open University, education
- hp Indigo, the electronic printing division of hp
- Cellcom, a leading Israeli cellular service provider
- ECI, telecom supplier
- Perrigo, pharmaceuticals
- Eden Springs, home office delivery
- Cisco, network management software
- Amdocs, billing systems
- Dead Sea Bromine Group, chemicals
- Bank Leumi, financial services
- Rafael, eletronics

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# Why Six Sigma ?

"At Motorola we use statistical methods daily throughout all of our disciplines to synthesize an abundance of data to derive concrete actions….

How has the use of statistical methods within Motorola Six Sigma initiative, across disciplines, contributed to our growth? Over the past decade we have reduced in-process defects by over 300 fold, which has resulted in a cumulative manufacturing cost savings of over 11 billion dollars"*.

**Robert W. Galvin**
**Chairman of the Executive Committee**
**Motorola, Inc.**

***From the forward to MODERN INDUSTRIAL STATISTICS by Kenett and Zacks, Duxbury, 1998**

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# Who implements Six Sigma ?

A.B. Dick Company, Abbott Labs, Adolph Coors, Advanced Micro Devices, Aerospace Corp, Airborne, Alcoa, Allen Bradley, Allied Signal, Ampex, Apple Computers, Applied Magnetics, ASQC, Atmel, Baxter Pharmaseal, Beatrice Foods, Bell Helicopter, Boeing, Bombardier, Borden, Bristol Meyers - Squibb, Bryn Mawr Hospital, Campbell Soup, Cellular 1, Chevron, Citicorp, City of Austin, TX, City of Dallas, TX, Clorox, Cooper Ind, Dannon, Defense Mapping
Agency, Delnosa ( Delco Electronics in Mexico), Digital Equipment Corp, DTM Corp, Eastman Kodak, Electronic Systems Center, Empak, Florida Dept. of Corrections, Ford Motor Company, GEC Marconi, General Dynamics, General Electric, Hazeltine Corp, Hewlett packard, Holly Sugar, Honeywell, Intel, Junior Achievement, Kaiser Aluminum, Kraft General Foods, Larson & Darby, Inc, Laser Magnetic Storage, Lear Astronics, Lenox China, Littton Data Systems, Lockhed Martin, Loral, Los Alamos National labs, Martin Marietta, McDonnell Douglas, Merix, Microsoft, Morton Int'l, Motorola, NASA, Nat'l Institute of Corrections, Nat'l Institute of Standards, Nat'l Semiconductor, Natural Gas Pipeline Company of America, Northrop Corp, PACE, Parkview Hospital, Pentagon, Pharmacia, PRC, Inc, Qualified Specialists, Ramtron Corp, Rockwell Int'l, Rohm & Haas, Seagate, Society of Plastics Egineers, Solar Optical, Sony, Star Quality, Storgae Tek, Symbios Logic, Synthes, Technicomp, Tessco, Texaco, Texas Commerce Bank, Texas Dept. of Transportation, Texas Instruments, Titleist, Trane, TRW,
Ultratech Stepper, United States Air Force, United States Army, United technologies, UPS, USAA, Verbatim, Walbro Automotive, Walker parking, Woodward Governor, Xerox, NovoNordisk, Glaxo, GE,.....

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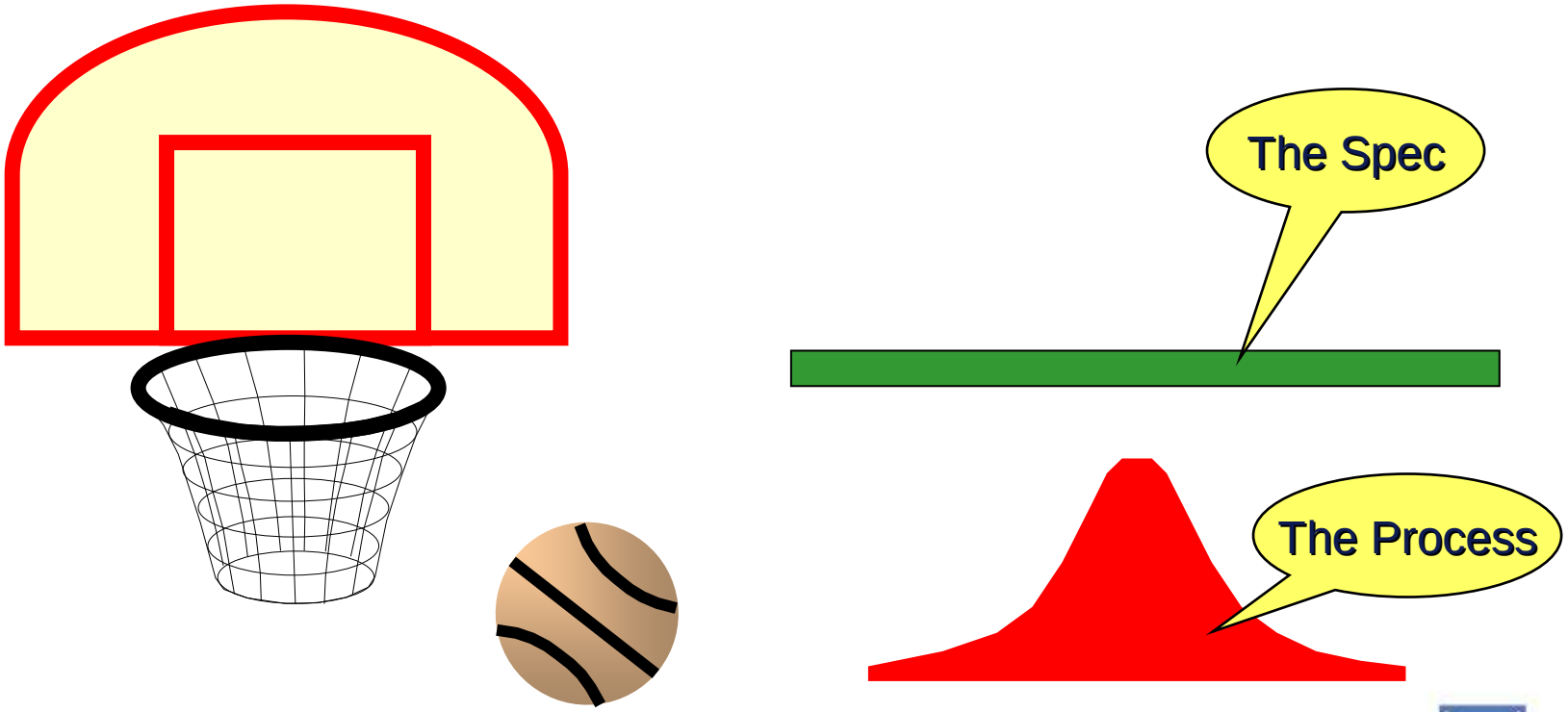
# The Basketball Analogy

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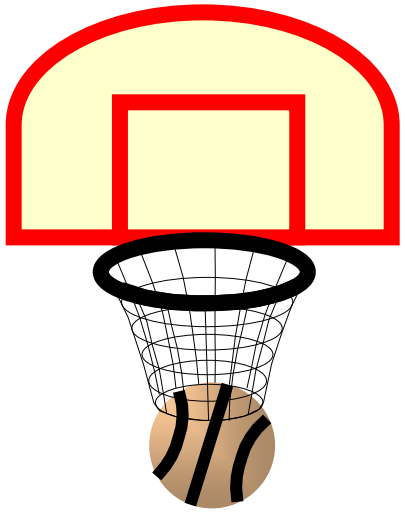
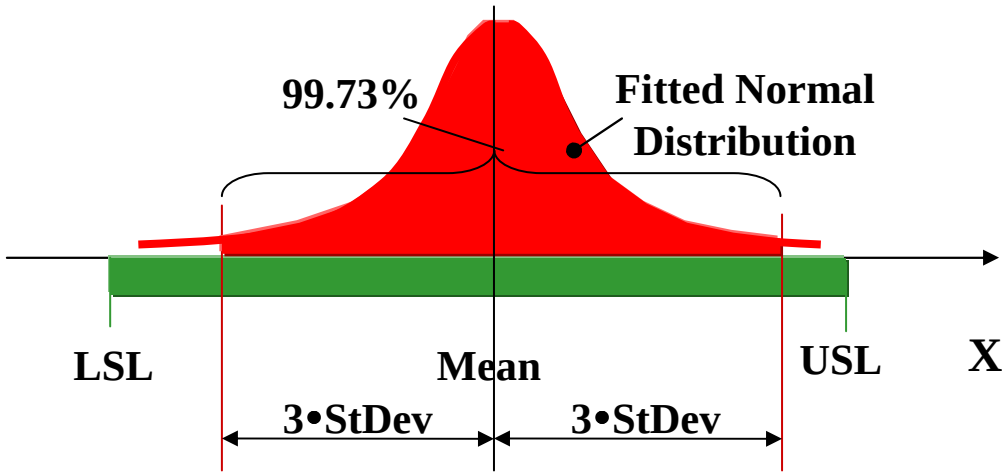
# The Basketball Analogy (2)






$$Cp = \frac{USL - LSL}{6 \bullet StDev}$$

$$Cpk = \frac{Min\ \{Mean - LSL,\ USL - Mean\}}{3 \bullet StDev}$$

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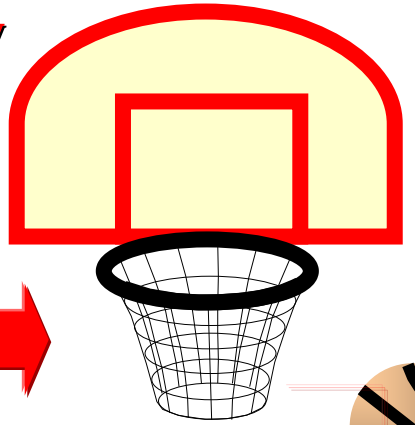
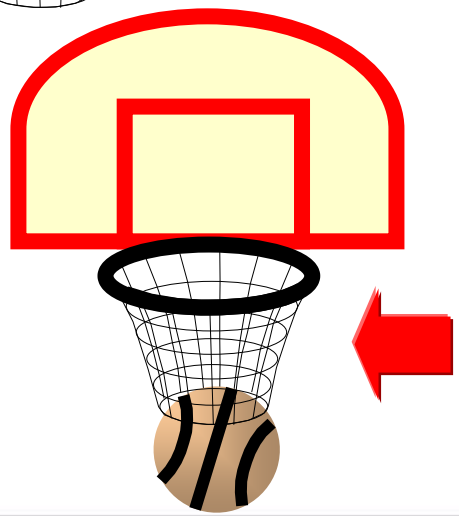
# The Basketball Analogy (3)

There is no Potential Capability



There is Potential Capability
However
There is no Actual Capability



There is Actual Capability

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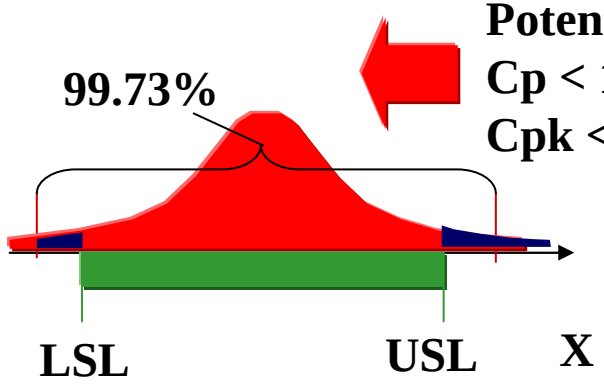
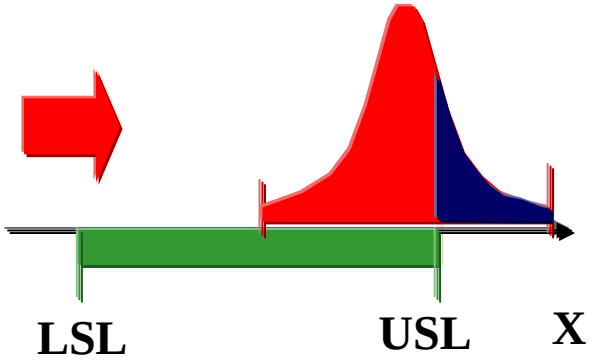
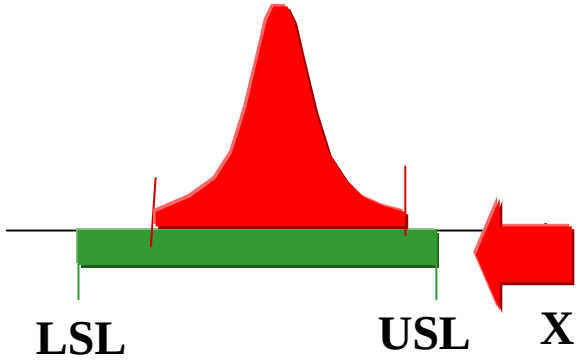
# Six Sigma Indicators

**There is no**
**Potential Capability**
**Cp < 1.0**
**Cpk < 1.0**




**There is**
**Potential Capability**
**There is no**
**Actual Capability**
**Cp > 1.0**
**Cpk < 1.0**




**There is**
**Actual Capability**
**Cp > 1.0**
**Cpk > 1.0**

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# Six Sigma Indicators (2)

## $C_p$, $C_{pk}$, Defects Per Million and Sigma Level

| $C_p$ | PPM | $C_{pk}$ | PPM | Sigma Level |
|---|---|---|---|---|
| 0.67 | 50,000 | 0.17 | 308,770 | 2 |
| 1.00 | 2,700 | 0.50 | 66,811 | 3 |
| 1.33 | 63 | 0.83 | 6,210 | 4 |
| 2.00 | 0.002 | 1.50 | 3.4 | 6 |

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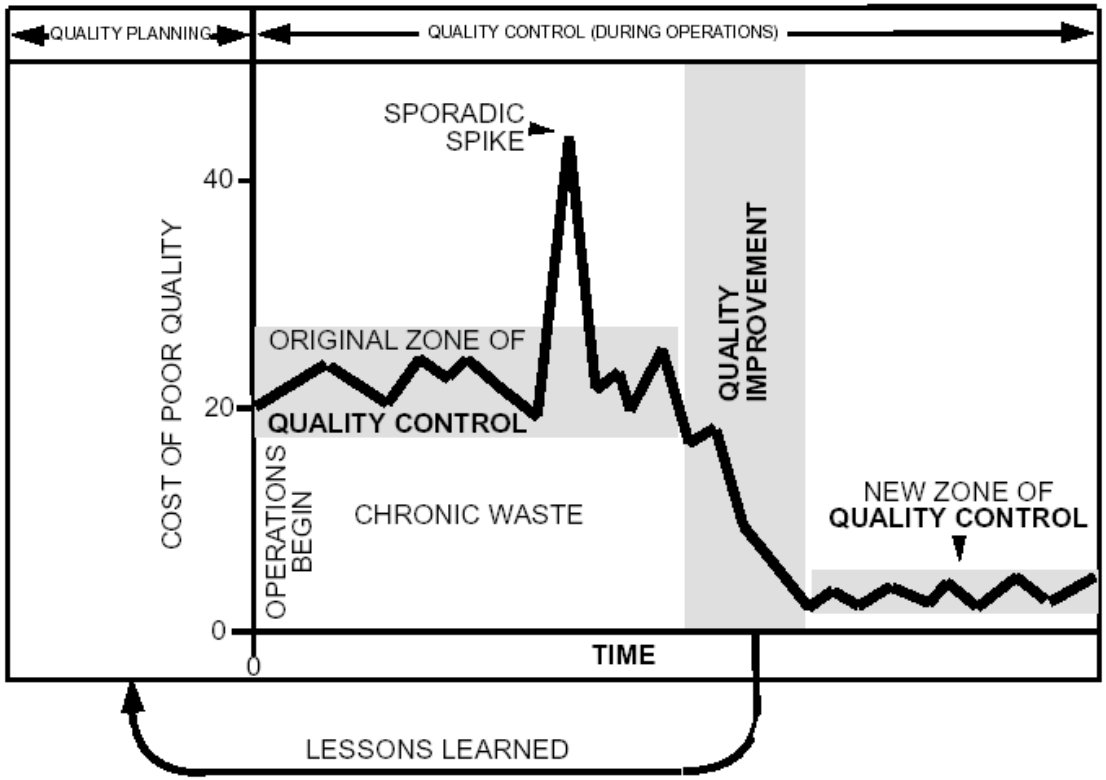
# The Juran Trilogy: Planning, Improvement and Control*

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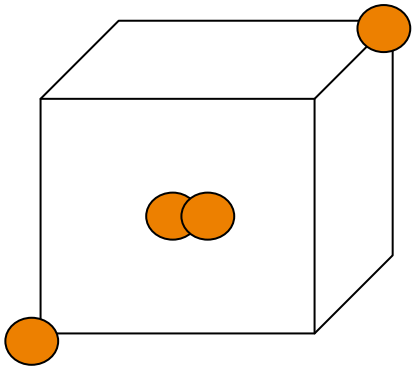
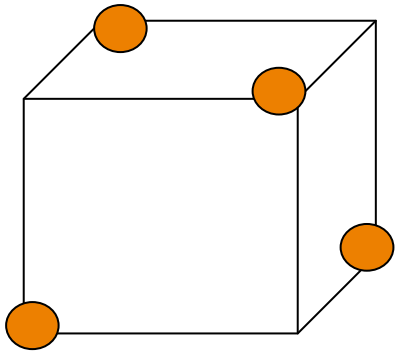
*J.M. Juran, *Juran on Leadership for Quality*, Free Press, 1989,

# Design for Six Sigma



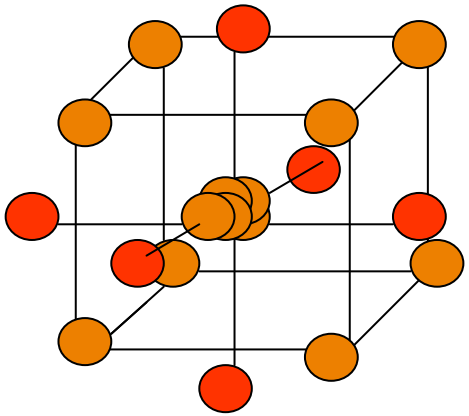
**Scoping**

Initial assessment



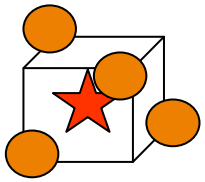
**Screening**

Fractional designs



**Optimizing**

Response surfaces



**Robustness**

Robust designs

**Process knowledge**

**Process Confidence**

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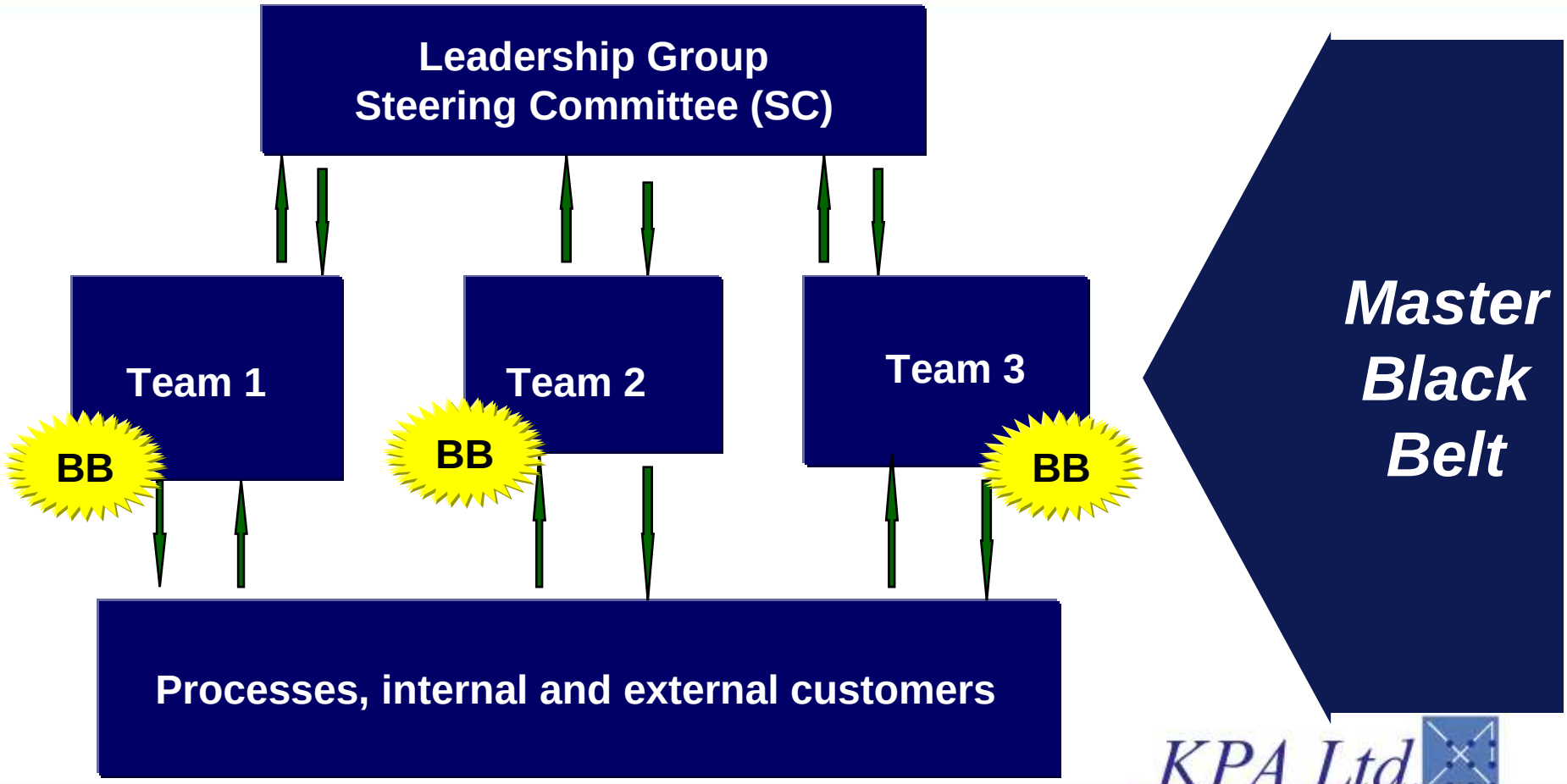
# The organizational structure
## Supporting Six Sigma implementation

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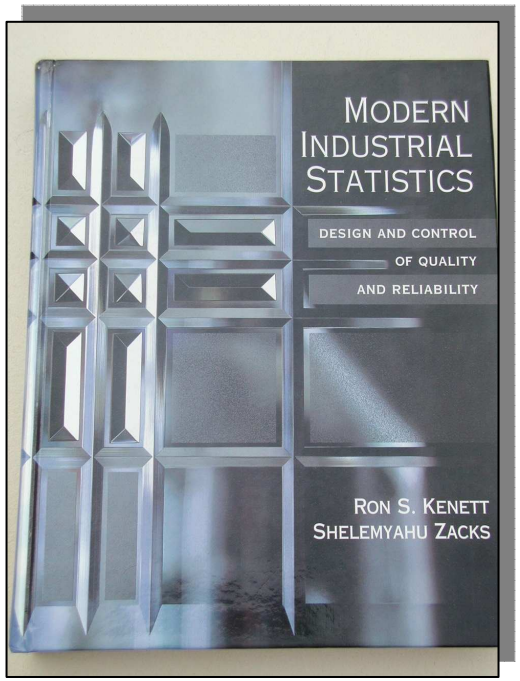
# Six Sigma Training

## Black Belt certification process




### Part I: Statistical Thinking

- Understanding Variability
- Variability in Several Dimensions
- Basic Models of Probability
- Sampling for Estimation
- Parametric Statistical Inference
- Computer Intensive Techniques
- Multiple Linear Regression and ANOVA

### Part II: Industrial Statistics

- Acceptance Sampling
- Statistical Process Control
- Advanced Statistical Control
- Design of Experiments
- Quality by Design
- Reliability

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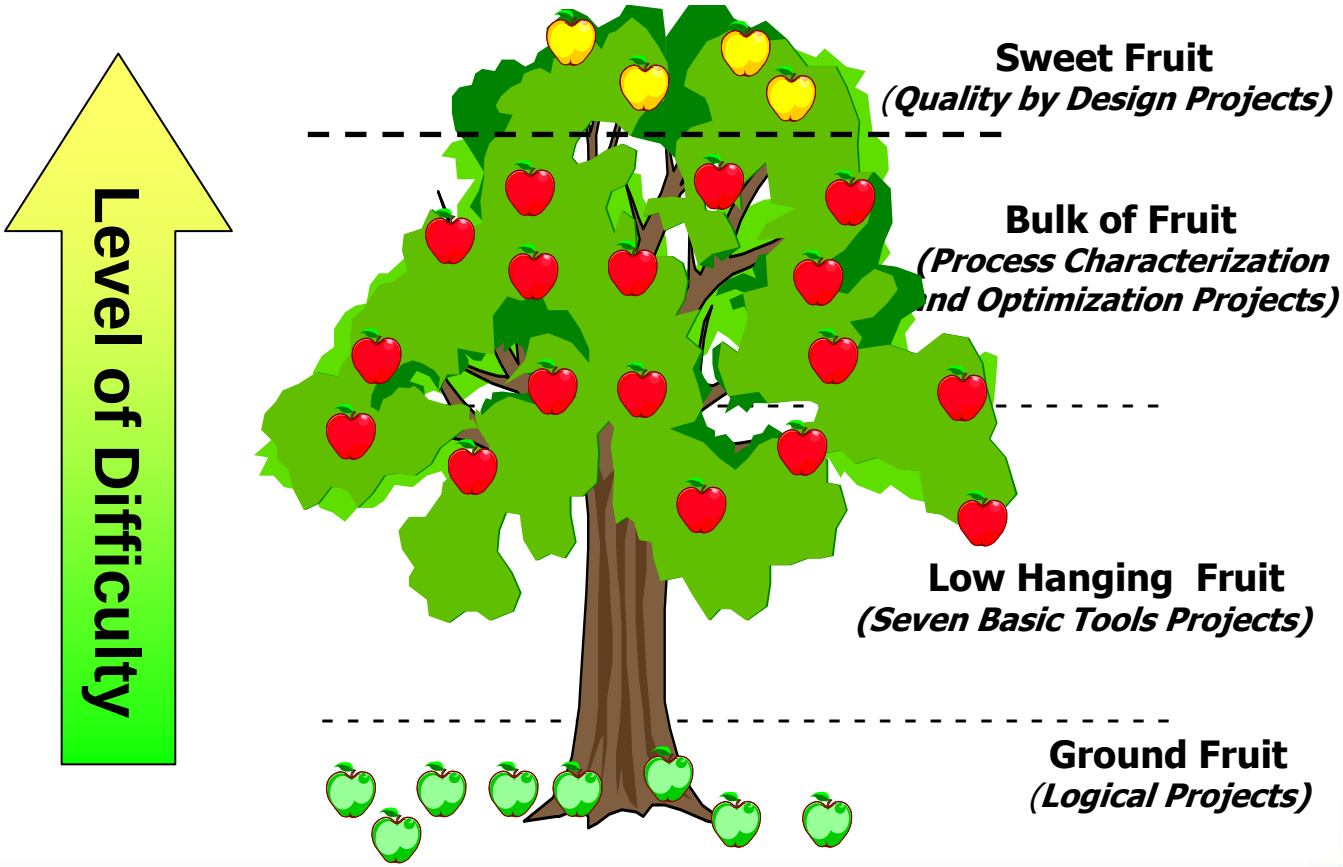
**MODERN INDUSTRIAL STATISTICS: Design and Control of Quality and Reliability, Kenett and Zacks, Duxbury Press, 1998 Spanish edition 2000, 2nd paperback edition 2002, Chinese edition 2004.**

# Project Identification




Design for Six Sigma

**DFSS**

Define-Measure-Analyze
Improve-Control

**DMAIC**

Collect-Organize-Launch
Perform-Implement

**Marathon**

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# Six Sigma Methodology

| | |
|---|---|
| DEFINE | Formulate the Mission by SC & assign team |
| MEASURE | Collect Data and Analyze Symptoms & Redefine the Mission |
| ANALYZE | Root Cause Analysis |
| IMPROVE | Recommend Improvement Plan to SC, Pilot Implementation and Change Management |
| CONTROL | Establish a control mechanism (measurement) Analysis Full deployment and Publication of Results |

DMAIC

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# Marathon Methodology

| | |
|---|---|
| Collect | Announce Marathons, collect suggestions |
| Organize | Create database and screen suggestions for Marathons, assign Sponsors |
| Launch | Design Marathons |
| Perform | Prepare Marathon<br>Perform Marathon |
| Implement | Implement Marathon decisions<br>Assess Marathon impact |

COLPI

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# Matrix Criteria Ranking

- List criteria to assess projects – brainstorming, eg
  - Impact on customer satisfaction
  - Required investment
  - Ability to implement etc.
- Select top 3 – voting
- Voters place their votes for each criterion
- Add up votes for each project
  - Scale by 1 (low), 2 (medium) or 3 (high)
- Select projects

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# Project Prioritization

## Project Evaluation Matrix

H = High  M = Medium  L = Low

| Topic | Impact | | | Required investment | | | Ability to implement | | | Score |
|---|---|---|---|---|---|---|---|---|---|---|
| | L | M | H | L | M | H | L | M | H | |
| High priority | 0 | 0 | 8 | 8 | 0 | 0 | 0 | 0 | 8 | 100 |
| Low priority | 8 | 0 | 0 | 0 | 0 | 8 | 8 | 0 | 0 | 0 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |

Low Impact

High Impact

Low Cost

High Cost

Low Ability

High Ability

Voters = 8

Number of participants

# Project Prioritization

## Project Evaluation Matrix

H = High  M = Medium  L = Low

| Topic | Impact | | | Required investment | | | Ability to implement | | | Score |
|---|---|---|---|---|---|---|---|---|---|---|
| | L | M | H | L | M | H | L | M | H | |
| High priority | 0 | 0 | 8 | 8 | 0 | 0 | 0 | 0 | 8 | 100 |
| Low priority | 8 | 0 | 0 | 0 | 0 | 8 | 8 | 0 | 0 | 0 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
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| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |
| | | | | | | | | | | -50 |

**Score =** **(impactH*3+impactM*2+impactL*1+ investH*1+investM*2+investL*3+ abilityH*3+abilityM*2+abilityK*1 -(3*#voters))*100/(6#voters)**

Voters = 8

# Six Sigma Roadmap - The Excel Tracking Sheet

Six Sigma Project Review Form

| Black Belt Candidate: | Date: | 1 | | 3 | | 4 | 5 |
|---|---|---|---|---|---|---|---|
| Project Name: | Reviewer: | | | | | | |
| Six Sigma Black Belt Methodology Phases | | Completed | Incomplete | Not started | % Weight | Action Items/Comments | |
| **A. MEASUREMENT** | | | | | | | |
| A1 | Problem identification. Key product/process selected, based on business impact (DPU, Yield, COPQ, etc) | 3 | 2 | 1 | | | |
| A2 | Project Customer, Mission, goals, metrics, client, measures of success established. | 3 | 2 | 1 | | | |
| A3 | Team members identified. | 3 | 2 | 1 | | | |
| A4 | Cashable return for Kodak identified (Return on investment) | 3 | 2 | 1 | | | |
| A5 | Potential barriers identified and listed. | 3 | 2 | 1 | | | |
| Items above (A1-A5) should be complete by Week 1 review | | | | | | | |
| A6 | Team formed and fully functional | 3 | 2 | 1 | | | |
| A7 | Project Baseline elements completed including scope, scale, analysis of defects, cycle time, and costs | 3 | 2 | 1 | | | |
| A8 | VOC collected, refined, and documented. | 3 | 2 | 1 | | | |
| A9 | Internal and external gaps identified through benchmarking | 3 | 2 | 1 | | | |
| A10 | Detailed process map documented (inputs, outputs, product/ process parameters, parameters classified, measurement points). | 3 | 2 | 1 | | | |
| A11 | Performance (key) parameters measured using basic Quality tools, basic statistics, and Six Sigma measures | 3 | 2 | 1 | | | |
| A12 | Project Management plan established including milestone dates and critical path | 3 | 2 | 1 | | | |
| Items above (A1-A12) should be complete by Week 3 review | | | | | | | |
| **B. ANALYSIS** | | | | | | | |
| B1 | Process/product data analyzed using control charts and other tools to determine stability, capability, variability and process limits | 3 | 2 | 1 | | | |
| B2 | Failure Modes and Effects Analysis performed using identified steps from product/process map. | 3 | 2 | 1 | N/A | | |
| B3 | Function Anaylsis Based Process Verification performed. | 3 | 2 | 1 | N/A | | |
| B4 | Systems Thinking tools applied (Reality Trees, Causal Loop Diagrams, etc.). | 3 | 2 | 1 | N/A | | |
| B5 | Key parameters prioritized based on capability analysis, defect pareto, cost analysis, FMEA, FAB-PV, Value Analysis, etc. | 3 | 2 | 1 | | | |
| B6 | Measurement System Analysis performed on key measurement processes (key parameters) | 3 | 2 | 1 | | | |
| B7 | "Measurement" phase elements updated (contract, baseline, metrics, flow maps, etc.). | 3 | 2 | 1 | | | |
| B8 | Project Management plan updated with proposed improvement strategy including milestone dates and critical path | 3 | 2 | 1 | | | |
| Items above (A and B) should be complete by Week 4 review | | | | | | | |
| **C. IMPROVEMENT** | | | | | | | |
| C1 | Key parameters selected for improvement. Response variables documented. | 3 | 2 | 1 | | | |
| C2 | Diagnostic studies completed (modeling, nested designs) | 3 | 2 | 1 | | | |
| C3 | Causal factor identification completed. Generate potential solutions. | 3 | 2 | 1 | | | |
| C4 | Factor levels established, design selected and factors loaded, DOE plan established | 3 | 2 | 1 | N/A | | |
| C5 | Experiment(s) conducted and data collected. | 3 | 2 | 1 | N/A | | |
| C6 | DOE analysis. | 3 | 2 | 1 | N/A | | |
| C7 | Select and test solution(s). Decision and risk analysis assessed. | 3 | 2 | 1 | | | |
| C8 | Implement solution(s). | 3 | 2 | 1 | | | |
| C9 | "Measurement" phase elements updated (contract, baseline, metrics, flow maps, etc.). | 3 | 2 | 1 | | | |

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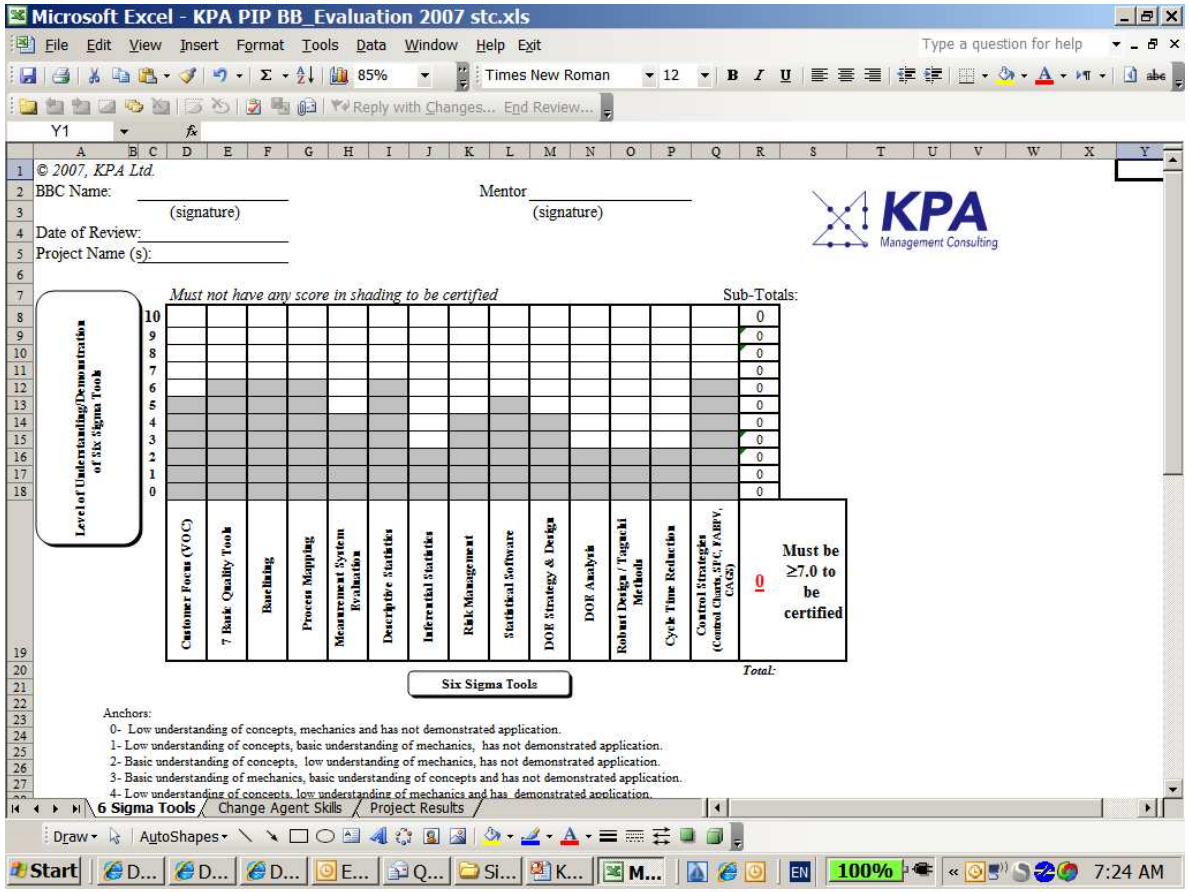
# Black Belt Training - The Excel Tracking Sheet

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# Six Sigma ROI

- In 1995 mandated each GE employee to work towards achieving 6 sigma
- In 1995 the average process at GE was 3 sigma
- In 1997 the average reached 3.5 sigma
- In 1998 investments in 6 sigma training and projects reached 45MUS$, profits increased by 1.2BUS$

**“the most important initiative GE has ever undertaken”.**

**Jack Welch**
**Chief Executive Officer**
**General Electric**

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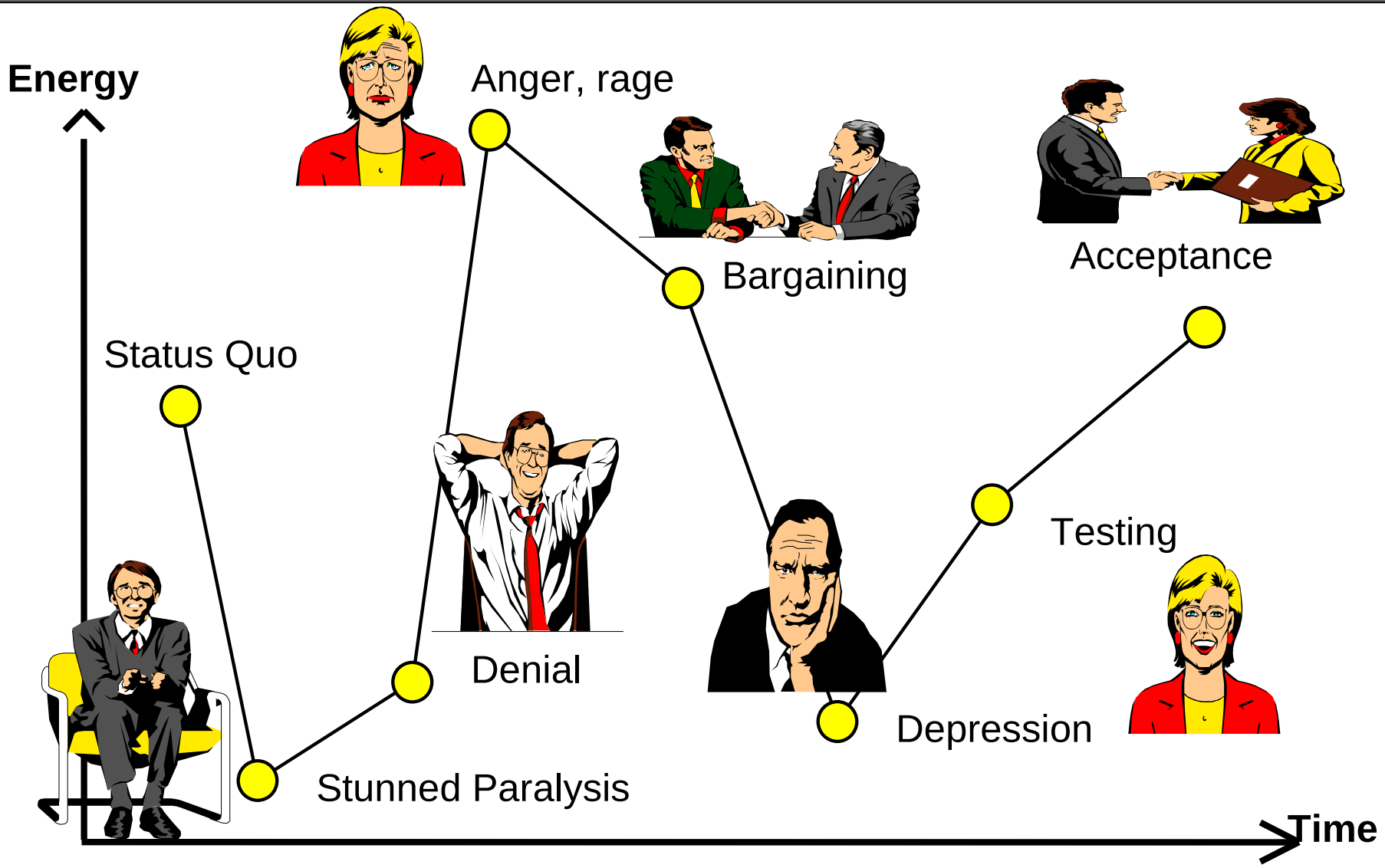


**Expect resistance to change!**


Thank you for your attention
and
good luck on your improvement journey
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