Basics of Quality Management
Lecture 5 – 15/10/2019

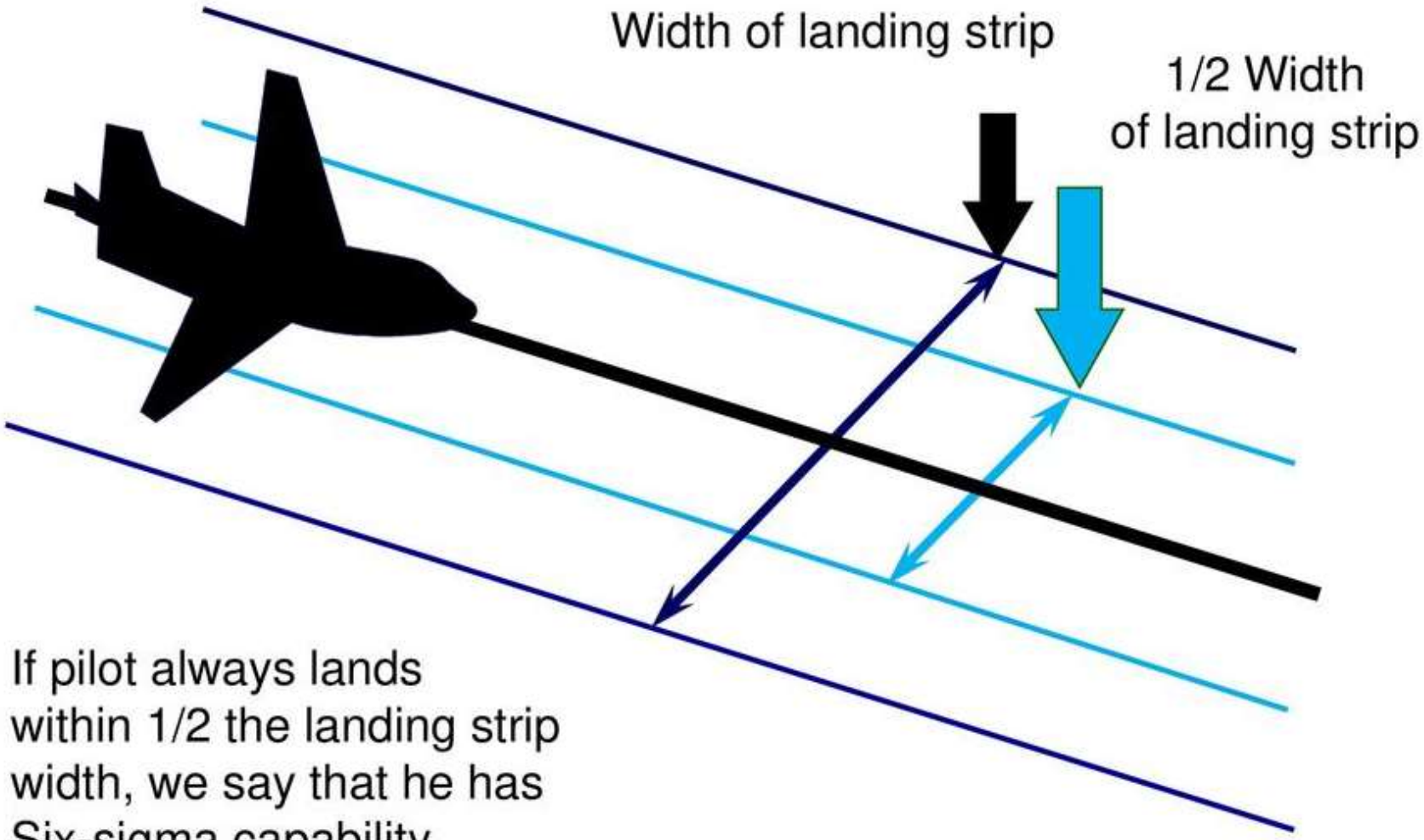
Petra BENEDEK
Assistant Lecturer

Department of Management and Business Economics
Faculty of Economic and Social Sciences
Budapest University of Technology and Economics
benedek@mvt.bme.hu

Agenda

- Six Sigma
  - Basics
  - DMAIC
- Lean Management
- Kaizen

A pilot's six sigma performance



If pilot always lands within 1/2 the landing strip width, we say that he has Six-sigma capability.

Meanings

- Six sigma as a statistical tool
  - focus: 3.4 dpmo
- Six sigma as a problem-solving process
  - DMAIC approach to process improvement
- Six Sigma as a philosphy
  - Defects are costly and can be eliminated
  - Understanding processes and improving them is the most efficient way to achieve lasting results

Definition of Six Sigma

A business improvement approach that seeks to find and eliminate causes of defects and errors in manufacturing and service processes by focusing on outputs that are critical to customers and a clear financial return for the organization

Increase profits
by providing
consistently good product or service

Evolution of Six Sigma

- 1st Generation (1984-1994) Motorola

  Reduce waste, improve quality

  (IBM, Texas Instruments, Xerox)

- Early Adopters (1993-2001) ABB

  Cost reduction. Business quality rather than quality business,

  DMAIC, project, regulated organization (Honeywell, GE)

- 3rd Generation (2001-) DuPont

  Value creation, Lean concept influence

Leadership challenges

- Delighting customers
- Reducing cycle times
- Technology advances
- Retaining people
- Reducing costs
- Responding quickly
- Flexibility
- New markets

Principles of Six Sigma

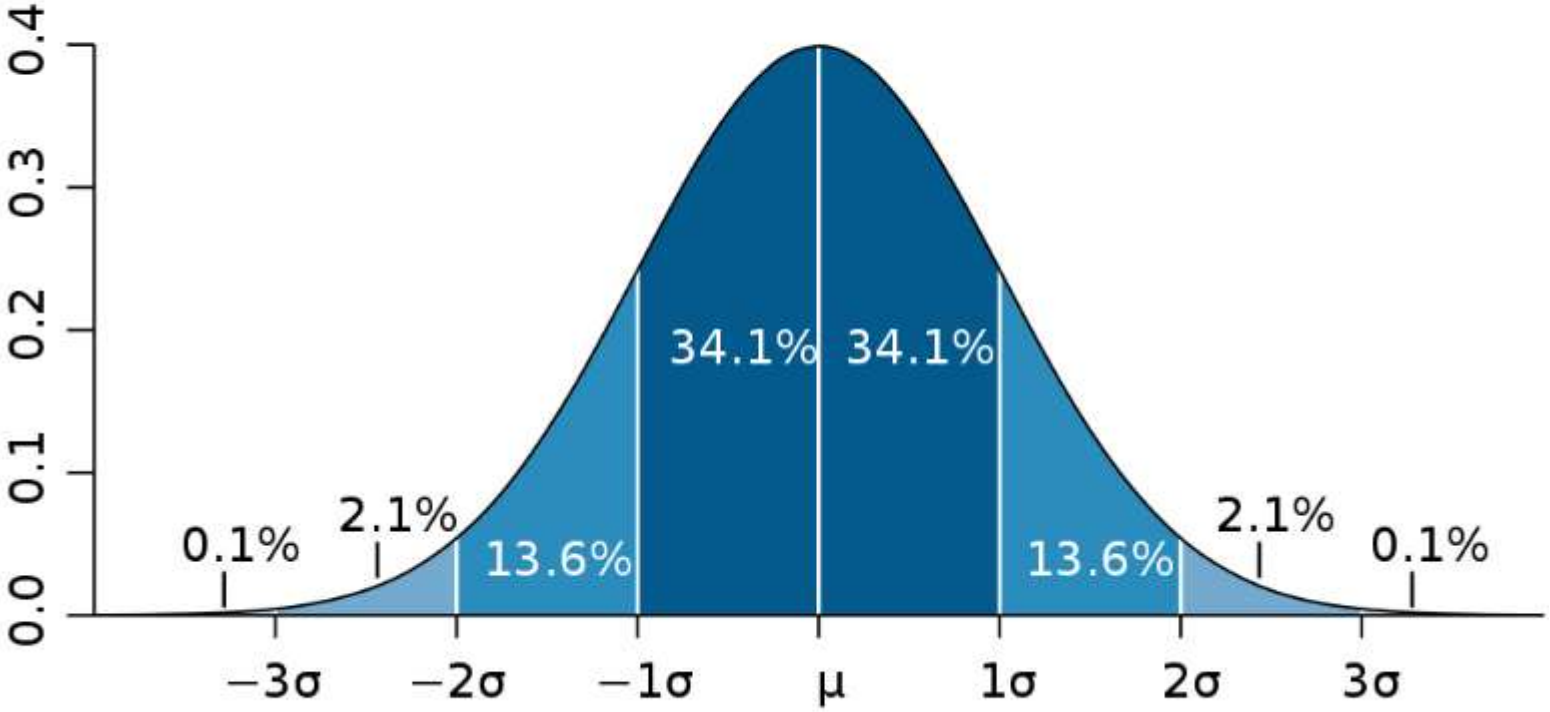
- Customer focus
- Data and fact driven management
- Process improvement focus
- Proactive management
- Boundary-less collaboration
- Drive for perfection
- Tolerance for failure

	TQM	Six Sigma
Workforce	Employee empowerment and total involvement	Higly qualified experts, project teams
Scope	Activities within a function/process/ workplace	Cross-functional
Training	Simple tools and concepts	Statistics and analysis
Finance	Little financial focus	Verifiable ROI
Processes	Continuous process improvement and standardization	Reducing process variations
Methods	PDCA	DMAIC
Primary effects	Growing customer satisfaction	Saving money
Secondary effects	Customer loyalty and performance improvement	Achieving business objectives and improving financial results
Criticism	High resource requirements	Project-by-project approach

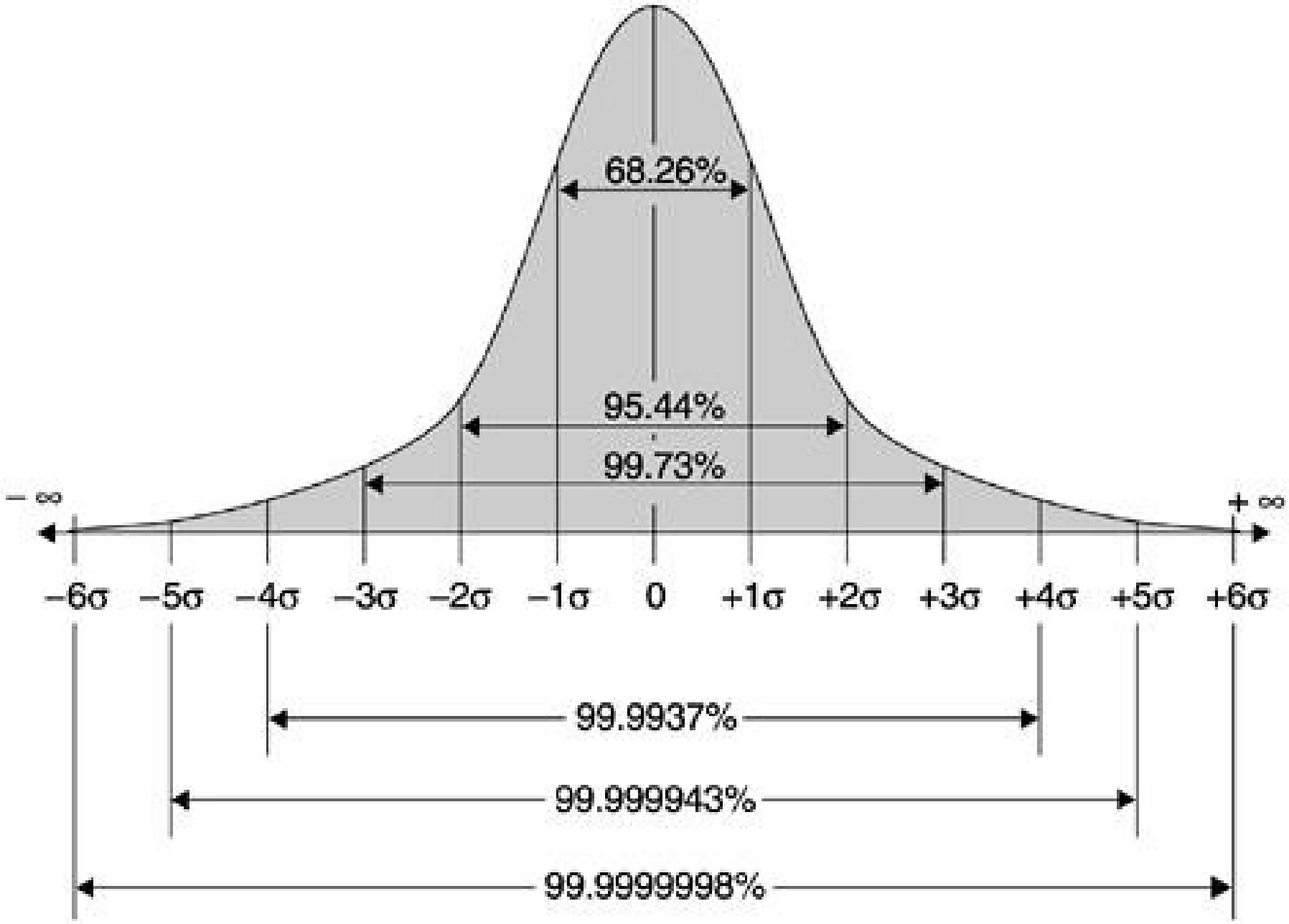
Concepts

- Mean - the sum of the values divided by the number of values (the average)
- Fluctuation - when a number of random processes occur, the outcomes fluctuate (vary in time)
- CTQ (critical to quality) - parametersof the process or service that relate to the needs and expectations of the customer

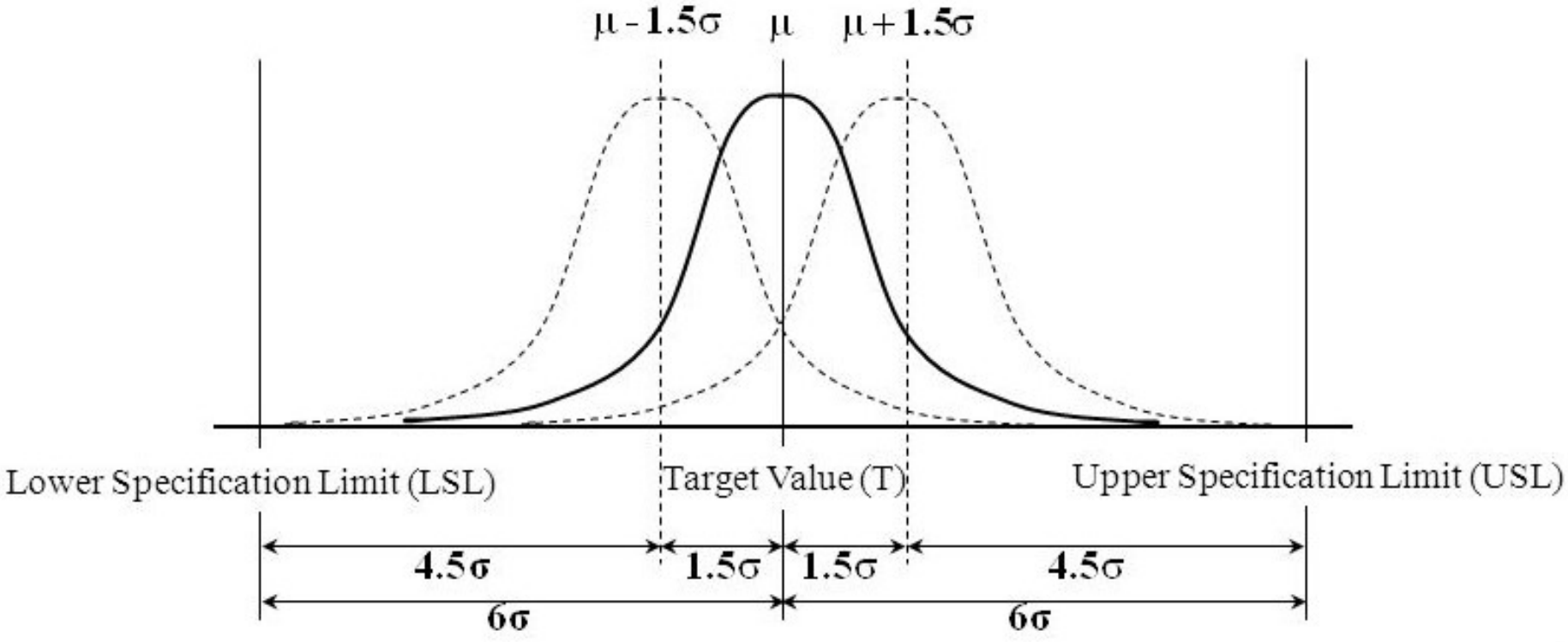
Mathematical statistical basics



99% performance (3.8σ)	99,99966% performance (6σ)
20 000 lost items per hour at the post in the USA	7 lost items per hour at the post in the USA
Uncertain quality tap water for about 15 minutes per day	Uncertain quality tap water for about 1 minute every 7 months
2 failed landings at the bigger airports each day	1 failed landing at the bigger airports every 5 years
10 uninterpretable X-rays per week	1 uninterpretable X-ray every 5 and a half years


68.26%
95.44%
99.73%
− ∞
+ ∞
−6σ
−5σ
−4σ
−3σ
−2σ
−1σ
0
+1σ
+2σ
+3σ
+4σ
+5σ
+6σ
99.9937%
99.999943%
99.9999998%

1.5 sigma shift



Nearly perfect

Sigma Level	DPMO
3.0	66807.2
3.5	22750.1
4.0	6209.7
4.5	1349.9
5.0	232.6
5.5	31.7
6,0	3.4

$$DPMO = \frac{1,000,000 \times \text{number of defects}}{\text{number of units} \times \text{number of Defects opportunities per unit}}$$

Defects Per Million Opportunities vs. Defective Parts Per Million

Six Sigma project selection

- Project by project improvement approach
- Project selection tied to organizational strategy
  - Customer and profit focus
- Project benefits tied to financial reporting system
  - Recognition and reward system

Management involvement

- Resource commitment
  - Financial commitment
- Actively selecting projects tied to strategy
- Setting up formal review process
- Determining strategic measures
- Integration with other systems

Teams

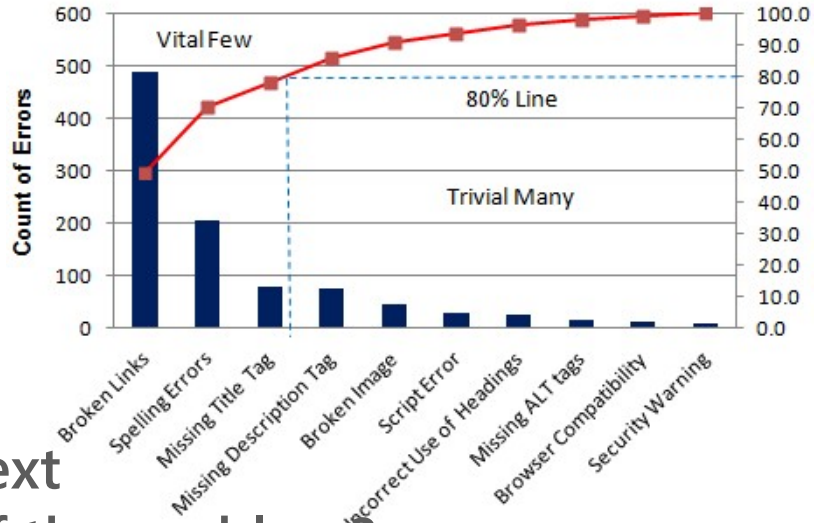
- Executive Leadership (CEO, top management) - vision, empowerment, overcoming resistance to change
- Champions – responsibility, mentoring
- Master Black Belts - as in-house coaches, identifying projects
- Black Belts - 100% time to Six Sigma, specific projects, project execution
- Green Belts - Six Sigma implementation along with their other job responsibilities

DMAIC – a process improvement methdology for existing processes

Mini case

- 1000 returned renewal cards each month
- 65% - the addressee has moved away
- Largest percentage: returns with forwardable addresses
- Pilot: compare against National Change of Address database – from 13,500 to 6,036 dpmo. Happy customers who received their credit cards
- Tracking the proportion of returns over time

1. Define



- „What is the problem?"
- Clearly define the problem
  - Background of the problem, context
  - Importance: What is the impact of the problem?
    - Define the impact on the customer
  - Scope – identify the specific problem
  - Understanding the process that drives the results
  - How often does this problem happen?
  - Project: timeline, team, budget, focus

- Methods that have been used successfully:
  - Cost of quality analysis
  - Pareto analysis (mess of symptoms - > vital few)
  - High level process mapping
  - Project charter - formal project mission statement

High level process map
SIPOC

Pizza Process

Suppliers	Inputs	Process	Outputs	Customers
• Dairy Supply Corporation • Vegetable Farmers United • Prepared Foods Corporation	• Cheese • Olives • Peppers • Dough • Sauce	• Prepare Dough • Add Sauce • Add Cheese & Toppings • Bake in oven • Remove from oven & serve	• Pizza	• Dine-in Customers • Take out Customers • Delivery Customers

Project Charter

Problem Statement

The Problem Statement should address these questions:

- What is wrong, not working and not meeting our customer's needs?
- When and where do the problems occur?
- What is the frequency of the problem?
- What's the impact of the problem on our customers/business or employees?
- What is the financial impact of the project and/or problem?

Business Case & Benefits

The Business Case should address these questions:

- Why is this project worth doing?
- Why is it important to do now?
- What are the consequences of not doing this project?
- How does it fit in with business initiatives and targets?

Goal Statement

[increase/Decrease] [Unit] from a baseline of [baseline] to a target of [goal level] by [date projected to reach target level]

Timeline

Phase	Planned Completion Date	Actual
Define:		
Measure:		
Analyze:		
Improve:		
Control:		

Scope - First/Last and In/Out

1st Process Step

Last Process Step

In Scope:

Out of Scope:

Team Members

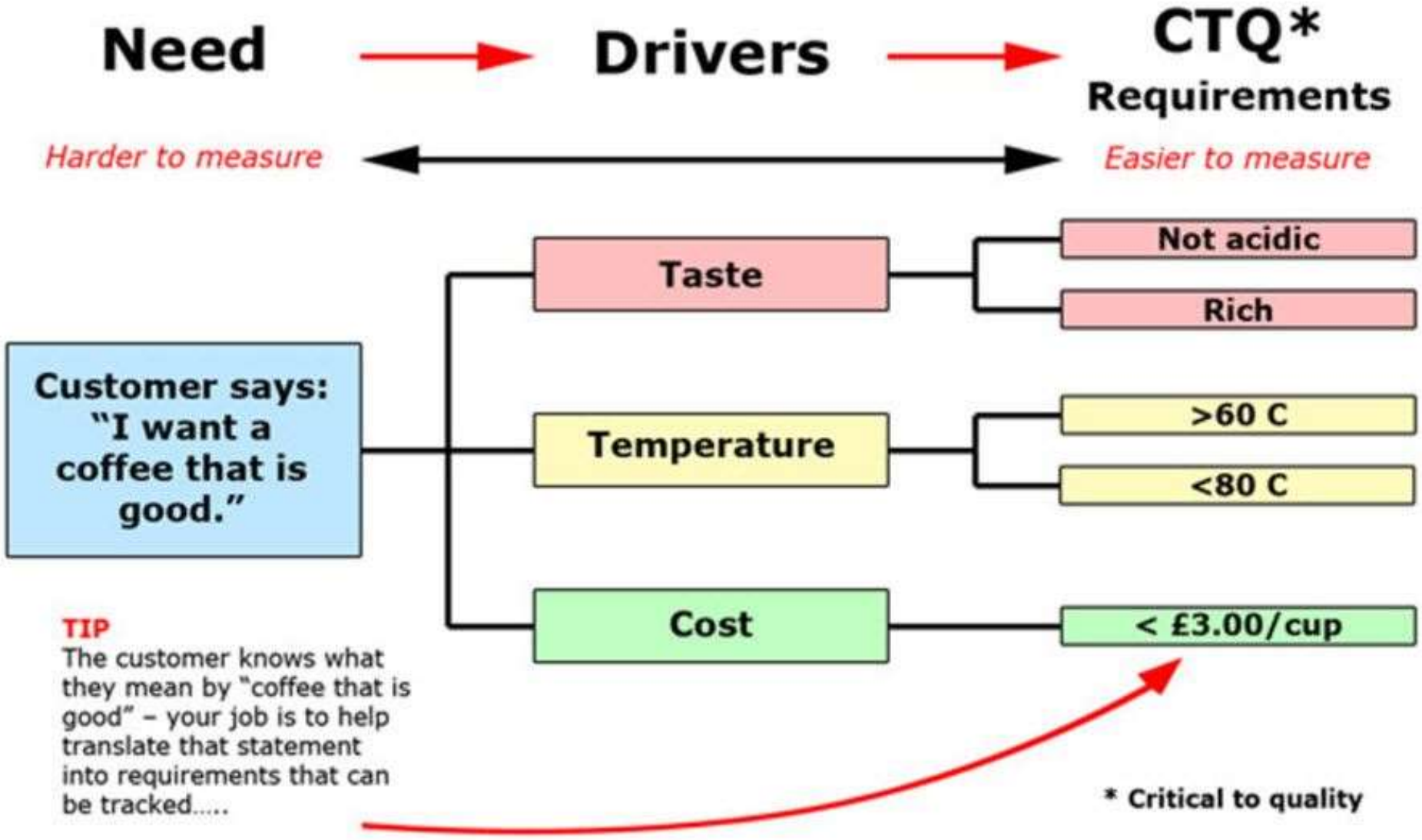
Position	Person	Title	% of Time
Team Lead			
Sponsor			
Team Member			
Team Member			
Team Member			

2. Measure

- „What about the system is not ideal?”
  „How do we measure it?”
- Understanding the current condition
  - Establishing the baseline, definitions
  - Process capability, specification limits
  - Critical to Quality (CTQ) parameters
  - Data collection. Evaluation. Reliability?

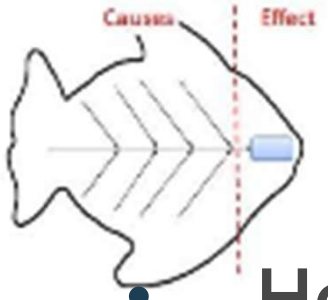
- Used successfully:
  - Data sheets
  - Check sheets
  - Benchmarking
  - Run charts

CTQ tree

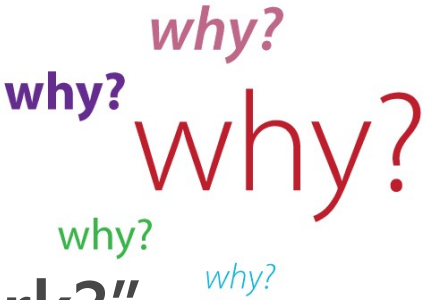

Need
Drivers
CTQ*
Requirements
Harder to measure
Easier to measure
Customer says: "I want a coffee that is good."
Taste
Not acidic
Rich
Temperature
>60 C
<80 C
Cost
< £3.00/cup
TIP
The customer knows what they mean by "coffee that is good" – your job is to help translate that statement into requirements that can be tracked.....
* Critical to quality

Check sheet

Defect Types ? (Major/ Minor)	Defects in Supplied Items							Total Count
	Sun	Mon	Tue	Wed	Thu	Fri	Sat	
Rusted Items		4	2		2	1		9
Items with Scratch	1							1
Dirty		1		3		2		6
Broken/ Cracks			2				1	3
Main Body Dent					3			3
Missing Components		2		2			1	5
Labelling Error					1	3		4
Damage in Packaging			2					2
Wrong Item Issued					2		1	3
Film on Parts			4					4
Voids in Casting	1					1	2	4
Incorrect Dimensions			2	1	2			5
Failed to pass the quality test		2				1		3
Total Count	2	9	12	6	10	8	5	52

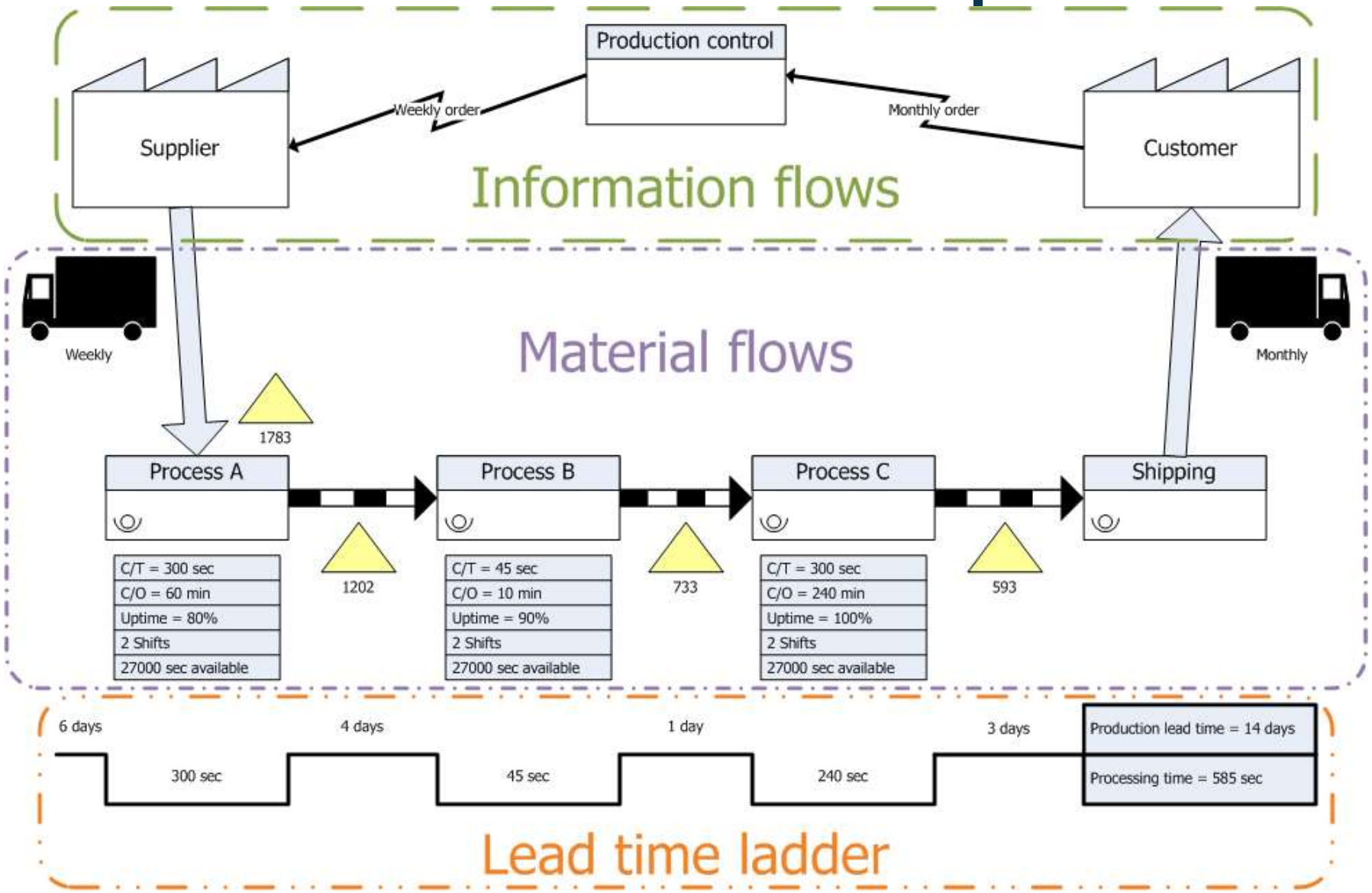


3. Analyze



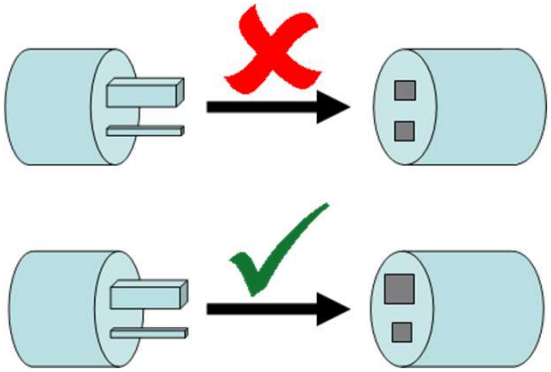
- „How does the process actually work?" „Why defects, errors, excessive variation occur?"
- Full understanding of the problem, identifying the root causes of variation
- Used successfully:
  - Detailed process mapping, flowcharts
  - Cause and effect diagrams (Ishikawa)
  - Failure mode and effects analysis (FMEA)
  - Root cause analysis
  - Statistical process control – how a process behaves over time, process capability
  - Sampling

Value stream map



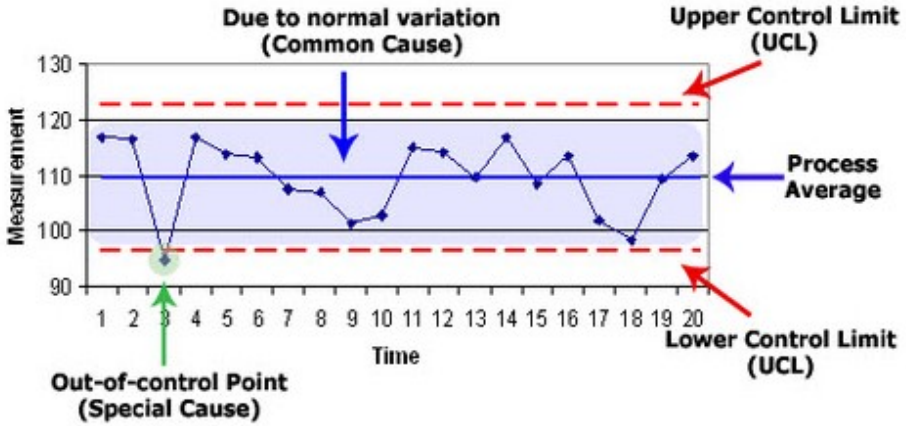
4. Improve

- „What are all the possible solutions?"
- Target conditions, possible improvement ideas, proposed new processes, measureable targets
- Developing solutions, root cause elimination
- Used successfully:
  - Brainstorming – no criticism
  - PDCA
  - Design of Experiments (DoE)



- Which solution works best?
  Confirm positive impact to CTQs
- Implementation plan: steps to achieve improvements (What? Who? When? Where? Cost?)

5. Control



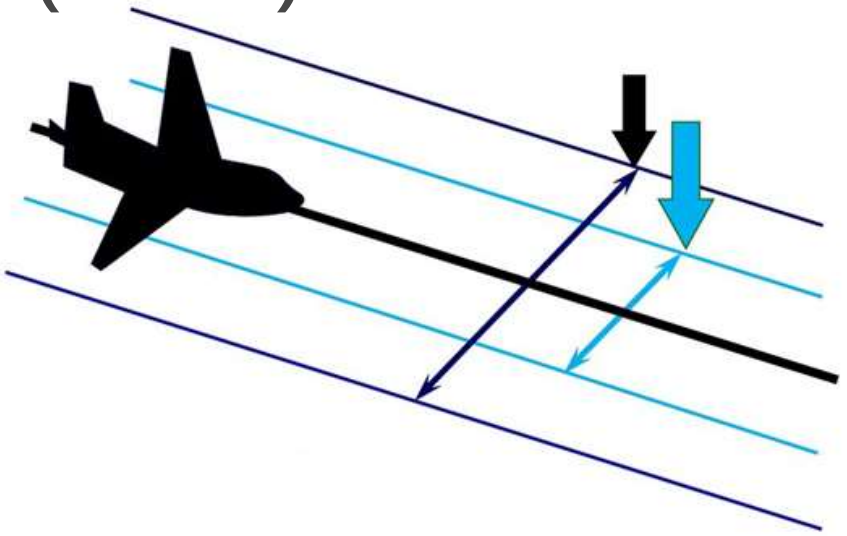
- „How to maintain the improvements?"
  „Have the improvements become *business as usual*?"
- Key variables should remain within the maximum acceptable ranges under the modified process – monitoring the performace of key measures
  - New standards (standard operating procedures)
  - New processes
  - Trainings, transition plans
  - New contols like checklists, status reviews, control charts, follow-ups

Notes

- 0 step: Recognize the right problem
- +1 step: Replicate and thank the team
- Advantages: simplicity and visualization to facilitate process improvement
- Iterative approach, breakthrough changes
- DMADV (Define, Measure, Analyze, Design, Verify) - redesigning a process or new process to match customer needs
- https://www.youtube.com/watch?v=Kz_7njsDUMQ
- Critisism

Six Sigma briefly

- Know what is important to the customer (CTQs)
- Reduce defects (DPMO)
- Centre around target (mean)
- Reduce variation



5 categories of problems

1. Conformance problems – Six Sigma
2. Efficiency problems – Lean tools
3. Unstructured performance problems – creative problem solving
4. Product design problems
5. Process design problems

LEAN MANAGEMENT

Lean management

- Reducing product costs through removing waste
- Value to the customer
- Identifying and eliminating non-value-added activities throughout the entire value chain
- „Getting more done with less”
- Faster customer response, reduced inventories, higher quality, better human resources

Toyota Production System I.
long-term approach

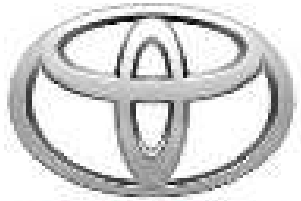
1. Base your management decisions on a long-term philosophy, even at the expense of short-term financial goals
2. Create a continuous process flow to bring problems to the surface
3. Use ‘pull’ systems to avoid overproduction.

Toyota Production System II.
how to produce the desired result

4. Level out the workload
5. Build a culture of stopping to fix problems, to get quality right the first time.
6. Standardized tasks and processes are the foundation for continuous improvement and employee empowerment
7. Use visual controls so no problems are hidden
8. Use only reliable, thoroughly tested technology that serves your people and process

Toyota Production System III.
creating value through the people

9. Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others
10. Develop exceptional people and teams who follow your company's philosophy
11. Respect your extended network of partners and suppliers by challeng them and helping them improve



TOYOTA

Toyota Production System IV.
learning based on fundamental understanding

12. Go and see for yourself to thoroughly understand the situation
13. Make **decisions slowly** by consensus, thoroughly considering all options; implement decisions rapidly
14. Become a learning organization through relentless reflection and continuous improvement

Lean production

- Focus on measures and continuous development
- Employee involvement, empowerment, realistic work standards
- Cross-trained workers
- Flexible and automated equipment
- Efficient machine layout
- Rapid setup and changeover
- Just-in time delivery and scheduling
- Preventive maintenance

Key tools

- 5S – a system for workplace organization and standardization
- Visual controls – status of a system at a glance
- Efficient layout and standardized work
- Pull production
- Single-minute exchange of die
- Total Productive Maintenance (TPM)
- Source inspection
- Continuous improvement

7 *mudas* – 8 wastes

Defects

Efforts caused by rework, scrap, and incorrect information.

Overproduction

Production that is more than needed or before it is needed.

Waiting

Wasted time waiting for the next step in a process.

Non-Utilized Talent

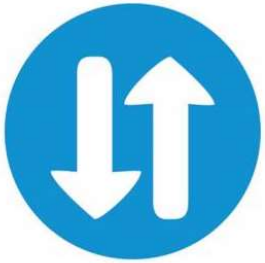
Underutilizing people's talents, skills, & knowledge.

Transportation

Unnecesary movements of products & materials.

Inventory

Excess products and materials being processed.



Motion

Unnecessary movements by people (e.g. walking).

Extra-Processing

More work or higher quality than is required by the customer.

Lean Six Sigma

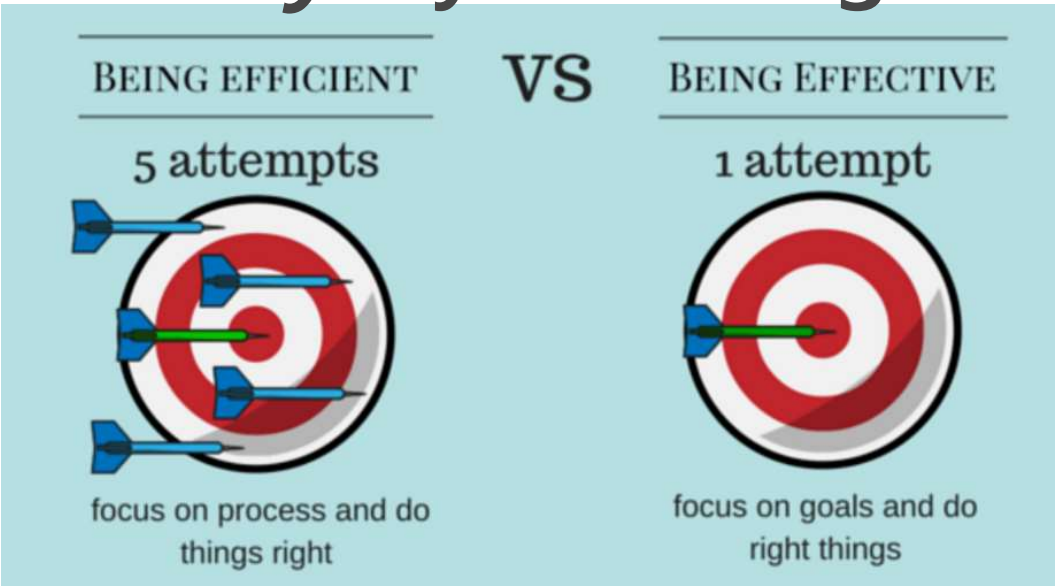
An integrated improvement approach to improve goods and services and operations efficiency by reducing defects, variation and waste

Lean AND Six Sigma

- Focus on customer requirements
- Focus on real savings
- Have the ability to make financial impact
- Not only in manufacturing
- Exploit data
- Logical problem-solving analysis

Complementary focus

Lean is focused on
efficiency by reducing waste



Six Sigma is focused on
effectiveness
by reducing errors and defects

KAI ZEN

改善

Change for Good

Kaizen – Change for the Better

- Empowerment
- Culture change
- Small, incremental changes
- PDCA

https://www.youtube.com/watch?v=xpELPDY82ds

Kaizen concept

- The intention to develop is based on the inner desire for harmony
- Everyone is able to work better and more effectively to make progress
- Development can be helped by learning, problem solving, and willingness to restart completely
- Development is unlimited

Kaizen principles

1. Eliminate
   (Is there a process element or component that can be eliminated?)
2. Merge
   (Merge certain work phases, can they be done at one time?)
3. Transfer
   (Can we improve the workflow by redeploying checkpoints?)
4. Simplify
   (Can it be different, easier to do?)

Kaizen in practice

- Clear goals
- Teamwork
- Time frame: a couple of weeks
- Creativity
- Quick and improvised, not elegant
- Use the necessary resources immediately available
- Immediate results at the end of the "week" are new production processes
- Increase Productivity by Eliminating Loss

https://www.youtube.com/watch?v=wot9DFzFRLU&t=14s

Midterm examples

- Six Sigma is a quality assurance system.
  True or false?
- What is the DMAIC cycle?
- What is the main purpose of Lean Management?
- List 3 wastes according to Lean Management, and give examples

THANK YOU
FOR YOUR ATTENTION

Petra BENEDEK

Assistant Lecturer

DEPT. OF MANAGEMENT AND BUSINESS ECONOMICS
FACULTY OF ECONOMIC AND SOCIAL SCIENCES
BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS

benedek@mvt.bme.hu