UNIVERSITÀ DEGLI STUDI DI TRIESTE

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335 211609

INDUSTRIAL PLANTS II

Chapter one ï part 1.3

Lean manufacturing

KAIZEN

DOUBLE DEGREE MASTER IN

ñPRODUCTION ENGINEERING AND MANAGEMENTò

CAMPUS OF PORDENONE

UNIVERSITY OF TRIESTE

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TECHNIQUES AND TOOLS					7 TOOLS	CORRELATION
						PARETO'S DIAGRAM
						ISTOGRAMS
						CONTROL CHARTS
						ISHIKAWA DIAGRAM
					ONE POINT LESSON	
					A3	5 WHYS
					KEY PERFORMANCE INDICATORS	
					5 S	
				YAMAZUMI	ANDON	FLAS
				TAKT TIME	VISUAL MANAGEMENT	GRO
			ERGONOMY	KANBAN	STANDARDIZATION	EMP
			TPM	KAIKAKU	PDCA	IN
			SMED	JIT	POKAYOKE	AGR
	QUALITY FUNCTION DEPLOYMENT	SPAGHETTI CHART	OEE	HEIJUNKA	KAIZEN	INFO
	WASTES	LABOUR TIMES STUDY	ONE PIECE FLOW	FROM PUSH TO PULL	SIX SIGMA	COM
	HOSHIN KANRI	CURRENT VSM	FUTURE VSM	PULL	JIDOKA	MOT RESE
	DEFINE THE	IDENTIFY THE	SET UP FLOW	MANUFACTURE PULLING THE		ATTE

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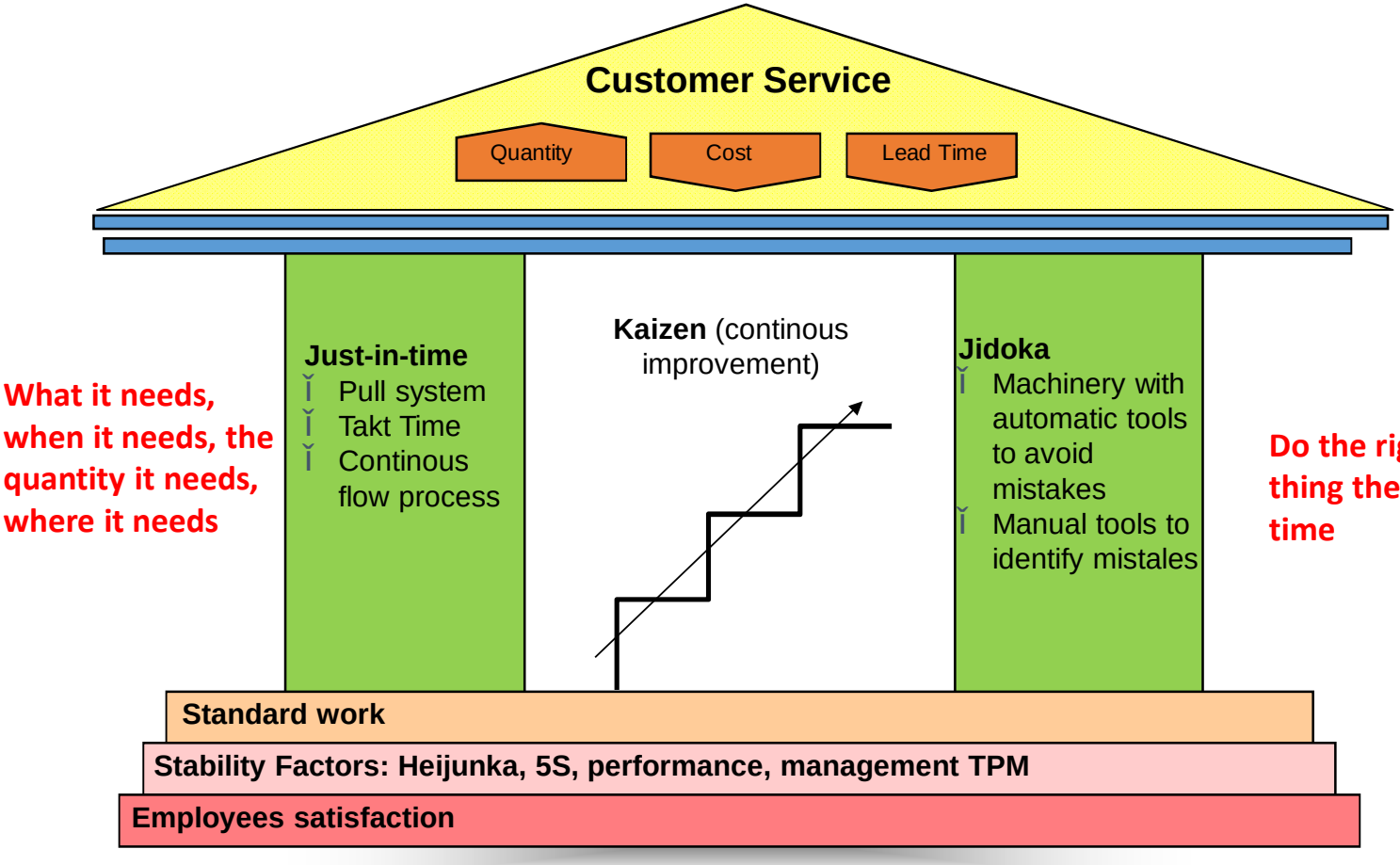
ñToyota Production Systemò



What it needs, when it needs, the quantity it needs, where it needs

Do the right thing the first time

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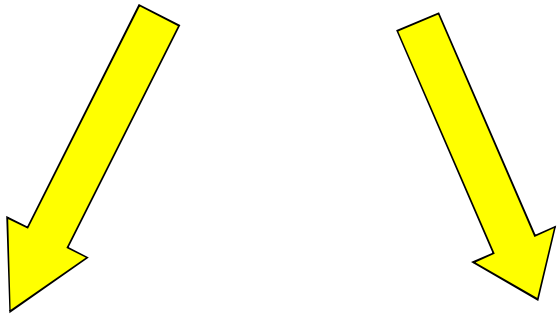
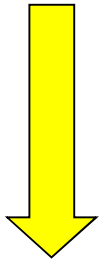
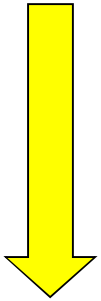


Kai = CHANGE



PARADIGM
WAY TO THINK
WAY TO ACT

Zen = IMPROVEMENT



PERFORMANCE

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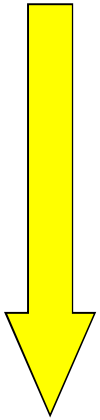
NEW APPROACH



TOTAL QUALITY MANAGEMENT

Do the right thing the first time, all and always

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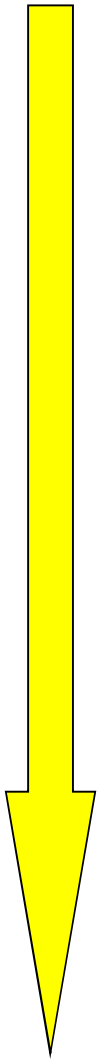
TOTAL QUALITY MANAGEMENT



CUSTOMER

CONSOLIDATED CUSTOMER

SATISFIED CUSTOMER

PROFIT IS THE PREMIUM

HIGH QUALITY

CONTINOUS IMPROVEMENT

PROCESS QUALITY

PROCESS IMPROVEMENT

FULL INVOLVEMENT

TRAINING AND LEARNING

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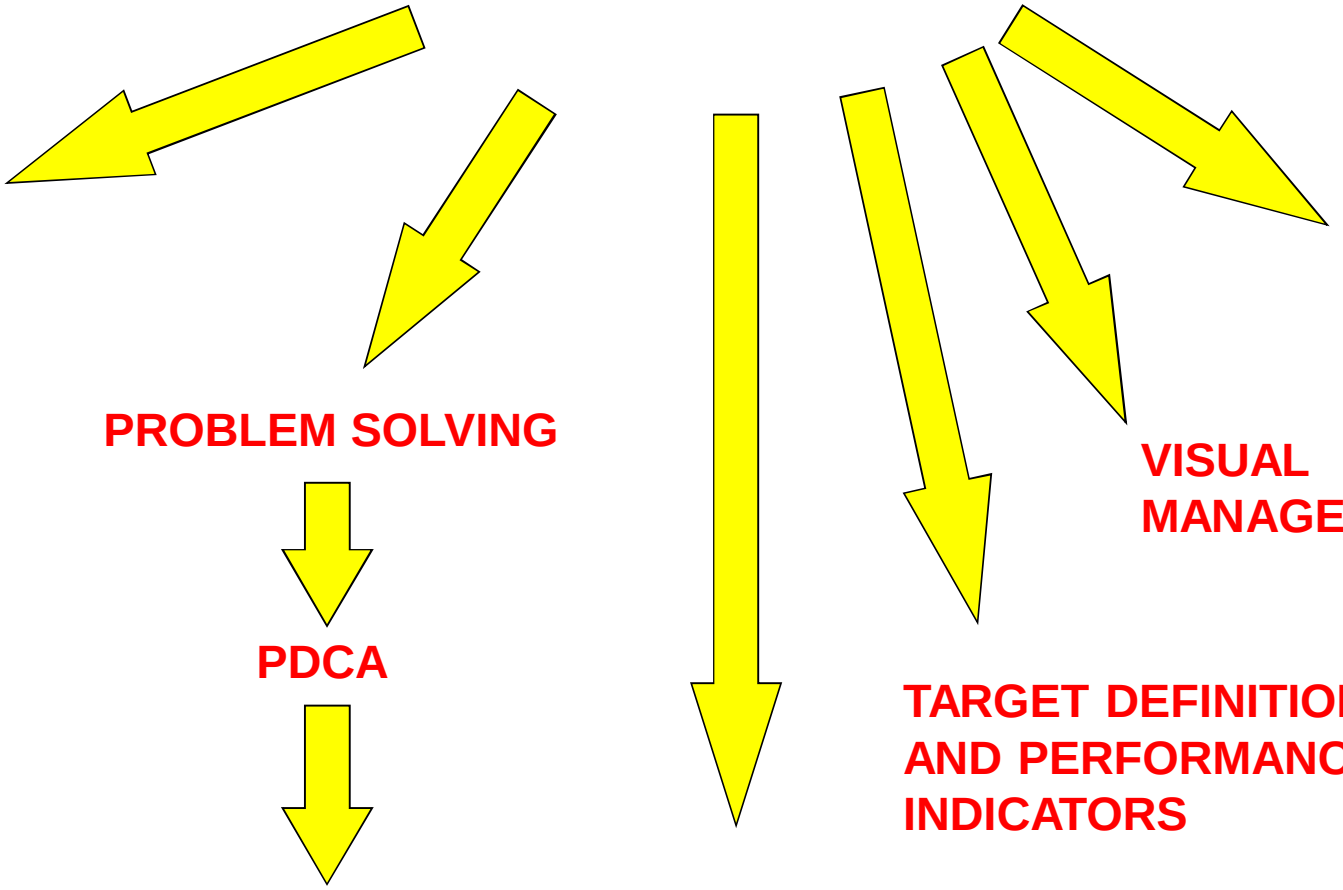
CONTINUOUS IMPROVEMENT



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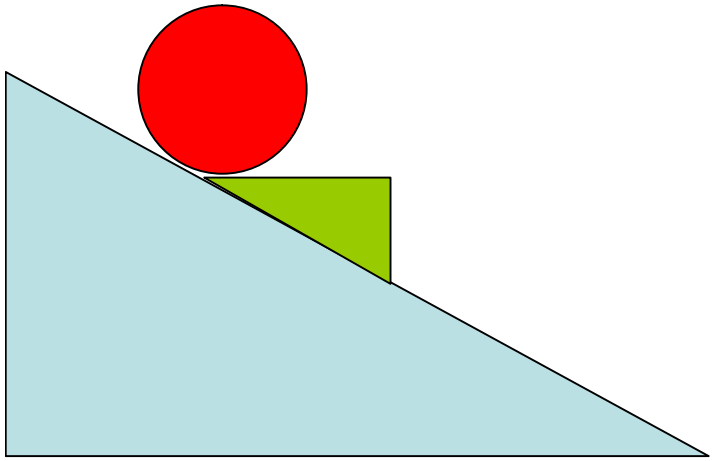
STANDARD

The standard is a formal and visible way to do things in an organized ambient that defines an operation done by an operator or a machine to get the best quality, quantity, safety and cost to the given conditions.



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SOME EXAMPLES IN OUR DAILY LIFE

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SOME BENEFITS DUE TO STANDARDIZATION

FOR THE COMPANY

- It makes operations repeatable, more effective and faster
- Maintains the quality level at the expected level
- It allows to control the compliance of the procedures
- It allows to balance the workload among operators
- Create the base for continuous improvement
- é é é é .

FOR THE EMPLOYEES

- makes operations repeatable, more effective and faster
- It reduces stress
- It provide rhythm to the work
- It Reduces wasted time to look for parts or tools
- It makes the operator's work more interesting as it has higher added value
- It gives the operator more control over the process, so as to be able to propose and develop improvements to the standard
- é é é é ..

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EXAMPLES OF OPERATIVE STANDARDS

Time measure table

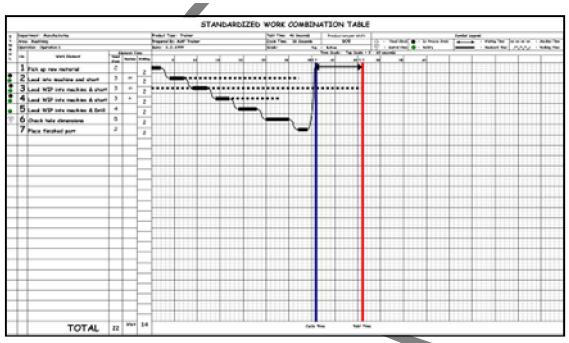
Process	Brazing	TIME MEASUREMENT SHEET																1
																		Dave/Craig
No.	Job Element	Measuring Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Lowest Repeatable Time
1	Pick-up raw material	Feet at raw material Bin	2	2	1	2	2	4	2	2	2	2	3	2	3	3	3	2
	Walk to Machine VX - 402	Turns towards VX - 402	2	2	2	4	7	5	5	5	2	6	4	4	4	4	2	2
2	Load part into machine/start	Hand touches WIP part	4	4	4	4	4	5	3	3	3	5	5	4	4	4	4	3
	Walk to Machine ZX - 590	Start Buttons released	2	3	3	3	3	2	3	3	3	5	2	2	4	6	2	2
3	Load part into machine/start	Step at machine	4	5	2	3	2	3	7	5	4	4	3	4	3	3	5	3
	Walk to Machine SX - 977	Machine door closed	3	4	3	4	4	4	2	2	5	3	2	2	2	4	2	2
4	Load part into machine/start	Foot touch safety mat	4	5	5	5	5	5	5	3	3	3	4	4	4	5	5	3
	Walk to Machine SX - 977	Sound of machine start	3	2	2	2	3	3	3	2	2	2	2	3	4	2	2	2
5	Load part into machine/drill	Set part down on machine	3	5	5	5	4	4	4	5	5	5	6	4	4	4	4	4
	Walk to Machine SX - 977	Drill disengaged	3	3	3	2	4	3	4	3	3	3	3	4	2	3	3	2
6	Check Hole Dimensions	Sound of part set on table	4	6	6	7	7	5	8	8	6	5	5	5	5	6	6	5
	Walk to Machine SX - 977	Turns to Finished parts	3	2	2	2	2	2	3	2	2	2	2	2	4	3	2	2
7	Place finished part	Steps at parts container	2	2	2	2	2	2	2	2	2	5	2	2	2	2	3	2
	Walk to raw material bin	Turns to Raw Material	2	3	2	3	2	3	2	2	3	3	3	2	2	2	2	2
Cycle Times																		36

Capacity per worker

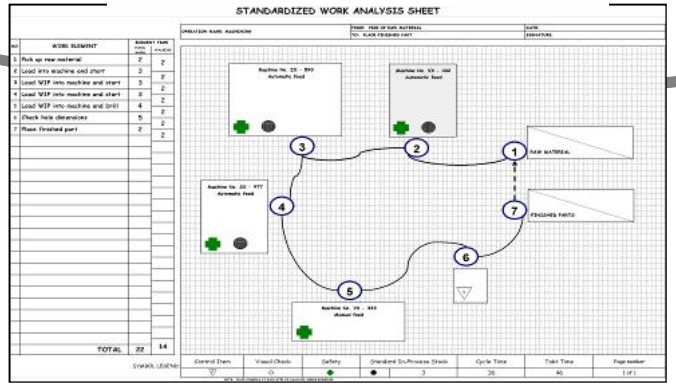
Manager	Frank	PRODUCTION CAPACITY							Part No.	123WWW...	Product Type	X	Section	135
Asst. Manager	Sue / Tom								Part Name	Example ABC	Parts/ Product	2	Name	Anna
													Available Time	27600

Sequence	Process Name	Machine No.	Time Standard: Manual Min.	Manual Exc.	AutoFeed Min.	AutoFeed Exc.	Total Min.	Total Exc.	Tool Changes: Interval of Changes	Tool Changes: Change-Over Time	Manufacturing Capability	Remarks
1	Chamfering	VX-402		3			25		28	100	100	952	3" 25"
2	Brazing	ZX - 590		3			21		24	1500	480	1136	3" 21"
3	Cutting	SX - 977		3			11		14	1000	301	1930	3" 11"
4	Drilling	YX - 333		4					4	1170	100	6756	4"
5	Quality Check	N/A		5					5				

"Combination table"



"Standard work chart"



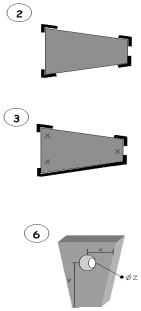
"Work instructions"

WORK INSTRUCTION FORM

Department: Manufacturing | Area: Machining | Operation: 1 | Product Type: Training | Prepared By: MMP Trainer | Page 1 of 1

NO.	OPERATION SEQUENCE	KEY POINTS
1	Pick up raw material	-Pick up narrow end of part with right hand first -Hold firmly in top left corner with left hand, using this for orientation
2	Load into machine and start chamfering machine	-Use left hand to align part into machine guides (see illustration 2) -Place narrow end of part into left side of machine first -Start machine by hitting buttons on either side of machine simultaneously with both hands
3	Load WIP into machine and start braze machine	-Align chamfer side of part with brazing tip datum's -Visually check alignment of part with brazing machine jigs, should not see any gaps between part and jig (see illustration 3) -Lock holding fixtures in place on part, two on chamfer side and one on opposite side of part -Engage brazing machine by closing door on machine
4	Load WIP into machine and start cutting machine	-Confirm braze quality visually using limit samples, part will be original color if cooled off -Place part frame side down into cutting fixture, bracket bracket will fit into opening -Do not force into fixture, go-no go gauge for brazed bracket -Engage machine by closing safety curtain and stepping off safety mat
5	Load WIP into machine and Drill part	-Remove any material from drill bit (must have gloves on) - Set braze side up against drill guides with right hand -Start drill by placing right hand on rubber handle with engage switch and left hand on press bar -Use left hand to press drill in smooth continuous movement down and up
6	Check hole dimensions	-Set braze side down in check fixture -Align with guides on each corner of part -Manually check hole location and diameter with jig by engaging to jig stop (see illustration 6) -Lock jig into place for accuracy (if not located correctly, jig will not lock)
7	Place part in finished part container	-Set part brazed side up in finished part container - Set parts left to right, back to front in container -Stack parts three high, take care to set lightly into container

ILLUSTRATIONS



RECORD OF CHANGE				
Date	Rev	Change Description	Sup.	T.L.
4/2/99	00	Initial issue		

SAFETY CONSIDERATIONS

- Others may not be aware that machines are running without operators
- Safety devices cannot be bi-passed for any reason

SIGNATURES			
Date	Shift	Supervisor	Operator Initials

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EXAMPLES IN DIFFERENT AREAS OF THE COMPANY

Production process

- Work place organization(5S)
- Work times
- Procedures and operative sequences

Materials flow

- Materials movements
- Material quantity per movement
- Movement decisions
- Stock area, warehouses and buffer

Information flow

- Production Planning
- Production instruction (kanban)
- Production Performances indicators

Other Processes

- Customers' orders management
- Suppliers management
- Invoices and payments management
- Employees Management

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KEY MESSAGES

- **Contrary to how they are usually perceived, creating standards is "natural"**
- **Operating standards are visual and formalized instructions that define and organize the work in each workplace (including e.g. cycle time)**
- **They are necessary for achieving optimal quality, safety, quantity and cost**
- **They are defined with the operators, applied by everyone and are periodically reviewed and improved**

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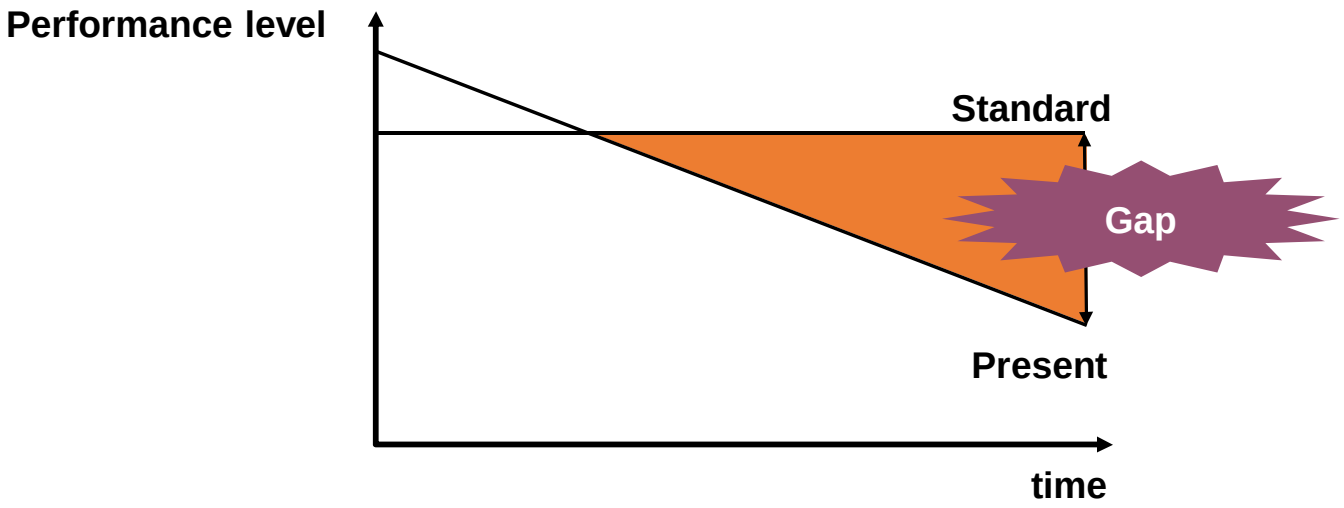
PROBLEM SOLVING

1) TO IDENTIFY THE PROBLEM ANDé

A problem can be defined as the gap between the standard and the present situation



é ADOPT TEMPORARY COUNTERMEASURES, INCLUDED THE PROCESS STOP

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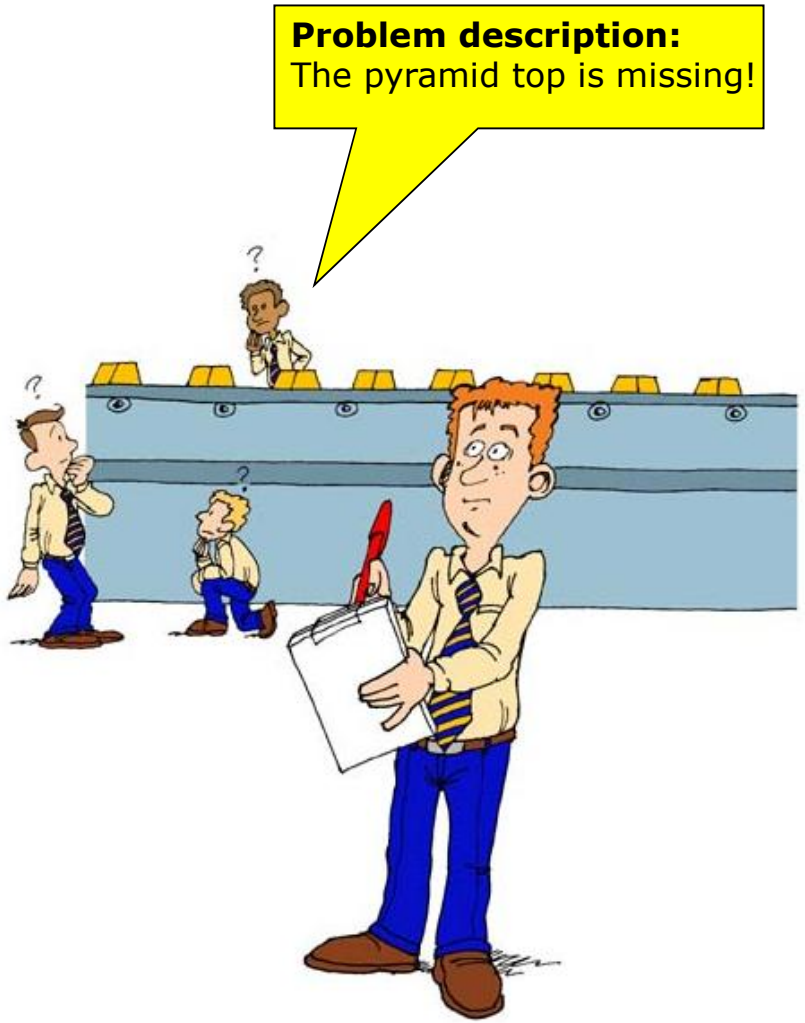
2) ACCURATE DESCRIPTION AND COMPREHENSION OF THE PROBLEM



The answer is"**GO AND SEE"!**

This is a scientific approach with common sense to Problem Solving.

In other words «we have to undestand what is really happening (**GENJITSU**) going into the production process (**GENBA**) and checking phisically the product (**GENBUTSU**)»

"I need only two tools – my eyes and my legs – By them I get information necessary to see, understand, judge, consider and decide."

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2) ACCURATE DESCRIPTION AND COMPREHENSION OF THE PROBLEM

Questions to define accurately the problem….

- The standard: what did we expect to happen?
- The gap: What really happened?
- The time period: How long is it happening?
- What is the target?
- ……..

5W + 2H :

WHEN
WHY
WHO
WHAT
WHERE

HOW
HOW MUCH

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3) RESEARCH, ALONG THE COMPLETE PROCESS, OF THE PLACE WHERE THE PROBLEM IS

Identify the place where the problem starts, not the place where you see the effect:

- **identify the origin point of the problem (in the factory, along the process, or somewherelse)**
- **identify the origin point of the problem, going backwards**
- **go to the GEMBA, do not work at your desk**

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4) SEARCH AND IDENTIFY THE «ROOT» CAUSE»

"5 WHYS" is the simplest tool to be used in Problem Solving immediately together with a session of brainstorming, utilising topics based on facts.

This tool has to be used supported by the 7 Quality tools:

1. **Cause/Effects Diagram – Ishikawa –**
2. **data collection sheets**
3. **Pareto Diagram**
4. **Istograms**
5. **Control Charts**
6. **Data Stratification**
7. **Correlation Diagrams**

5 WHY

5W + 2H :

WHEN
WHY
WHO
WHAT
WHERE

HOW
HOW MUCH

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4) SEARCH AND IDENTIFY THE «ROOT» CAUSE»

***Problem*: Customer is angry because his dishwasher stopped after only few days from its installation**

1° Why did the DW stopped after few days from its installation?

Answer: because the differential switch opened the circuit.

2° Why did the differential switch open?

Answer: because drops of water have fallen on an electrical contact.

3° Why have drops of water fallen an electrical contact?

Answer: because the gasket of the heating element placed in the water boiler tank above the electrical contact had a sealing problem..

4° why does the heating element gasket have a sealing problem?

Answer: because the hole where the heating element is inserted in the boiler tank is deformed.

5° why is the hole where the heating element is inserted in the tank deformed?

Answer: Because the stamping punch has not been properly hardened.

The ultimate cause was therefore the incorrect hardening of the punch, which along the time has worn out. The solution is to write the instructions to perform the quenching correctly and to run the process FMEA which, was not done correctly during the dishwasher design development.

Note that the example now illustrated is the same as shown in the sheet relating to the Ishikawa diagram.

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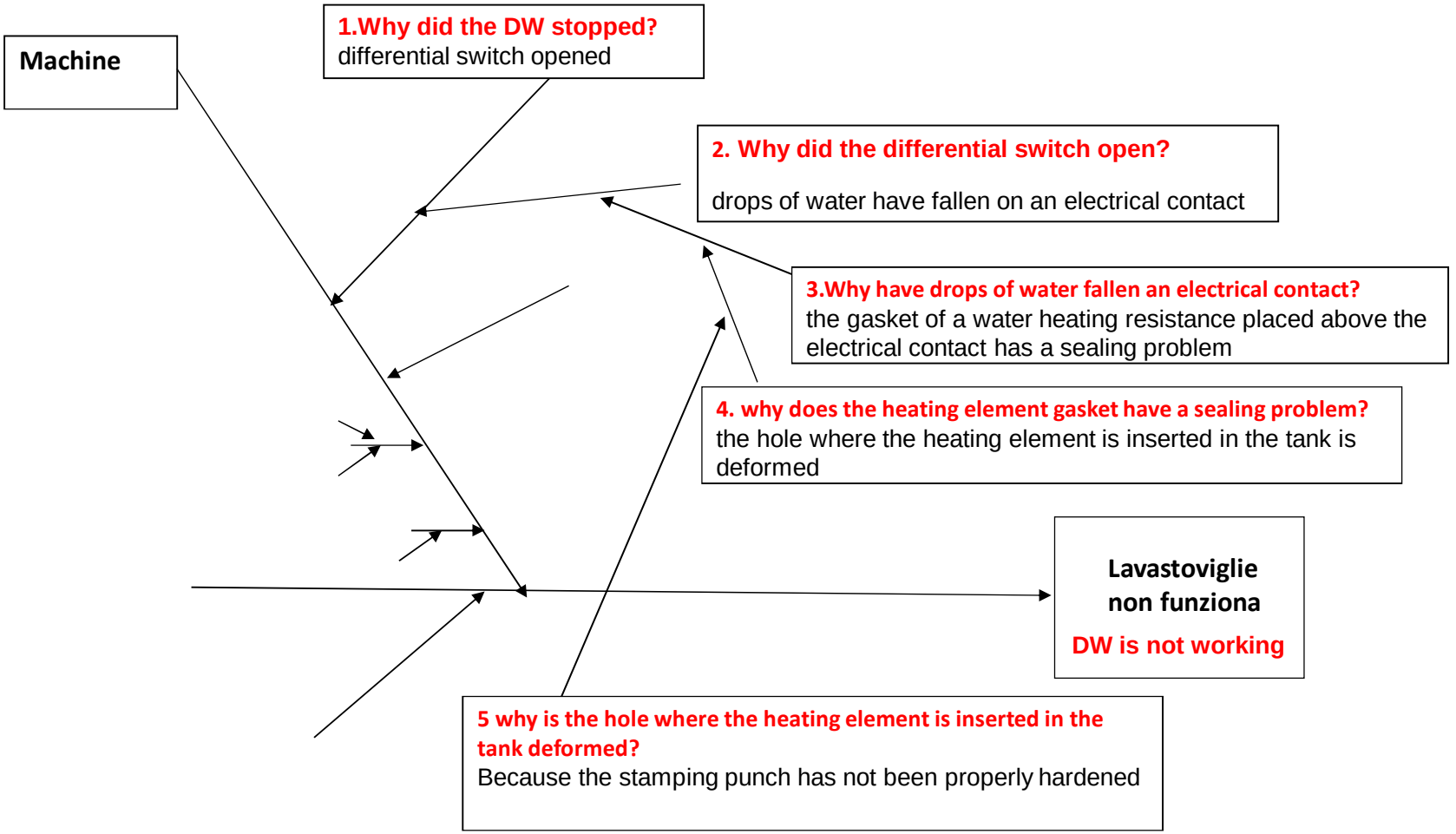
4) SEARCH AND IDENTIFY THE «ROOT» CAUSE»

PLEASE, BUILD THE ISHIKAWA'S DIAGRAM

4) SEARCH AND IDENTIFY THE «ROOT» CAUSE»



Ishikawa's Diagram

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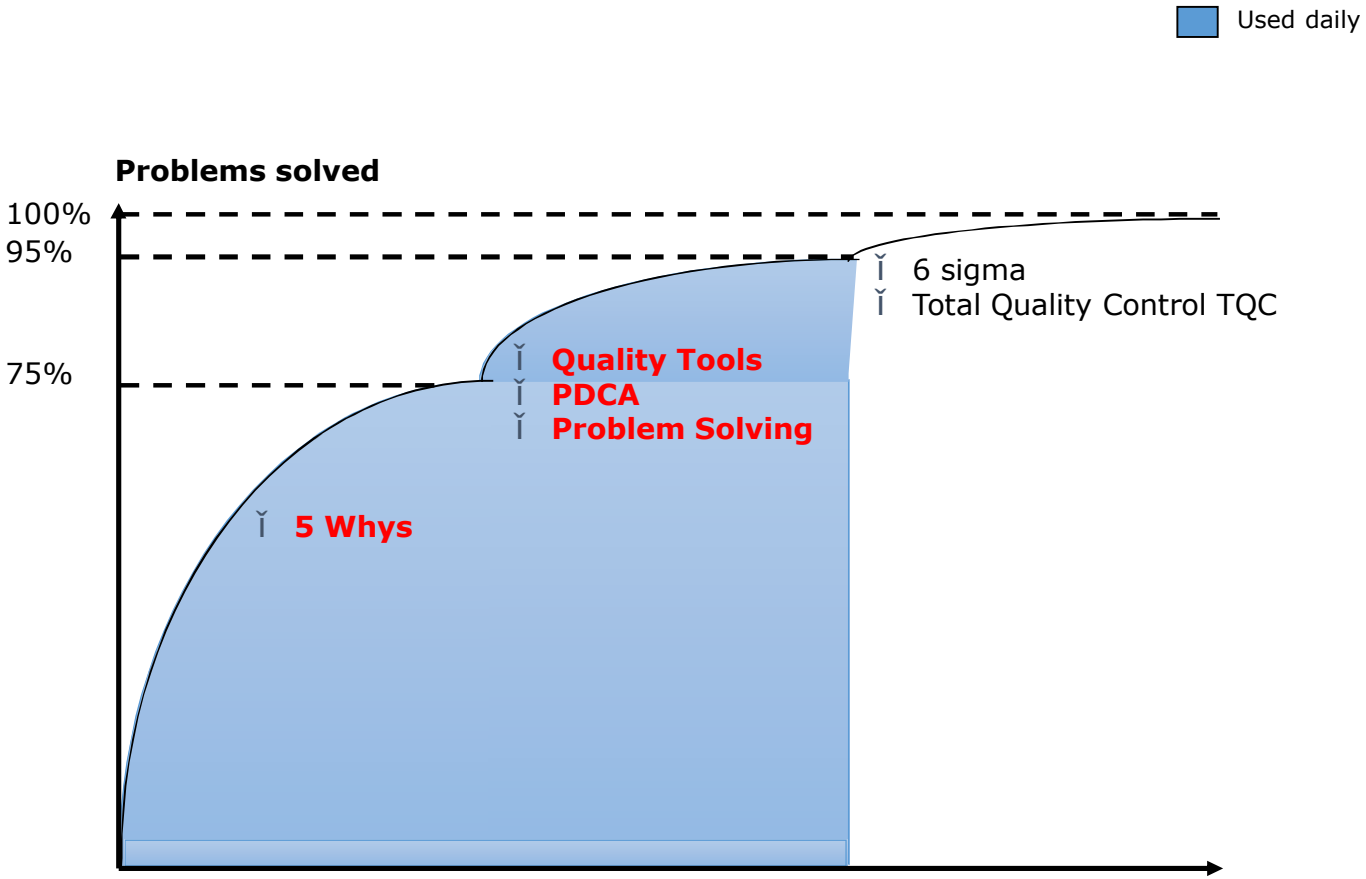
TOOLSôEFFICACY



Some problems required bigger efforts to be solved – Lean companies use the simplest tools at the beginning and later the most complex

FONTE: McKinsey

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5) IDENTIFY THE SOLUTION AND DO AN ACTION PLAN

Be careful not to assume as definite a solution that is only temporary (a sort of plaster)!

ACTIONS:

- **Immediate action to contain the problem**
- **Long term Action**

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6) CONTROL AND FOLLOW-UP

- Fix an agenda to verify the problem solution and possible revisions

- Order the main stages toward the solution
  - Progress assessment with stakeholders to review and / or gain consensus
  - Communicate and update employees

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7) STANDARDIZATION AND SUSTAINABILITY

- **CREATE THE NEW STANDARD TO IDENTIFY THE NEW PERFORMANCE**
- **UPDATE THE RELATED PROCESS DOCUMENTS, WHERE THE NEW STANDARD IS REPORTED**
- **MONITOR THE SUSTAINABILITY OF THE NEW STANDARD BY:**
  - **Data provided daily by the workers**
  - **Daily verification done by team leaders**
  - **Periodic audits**

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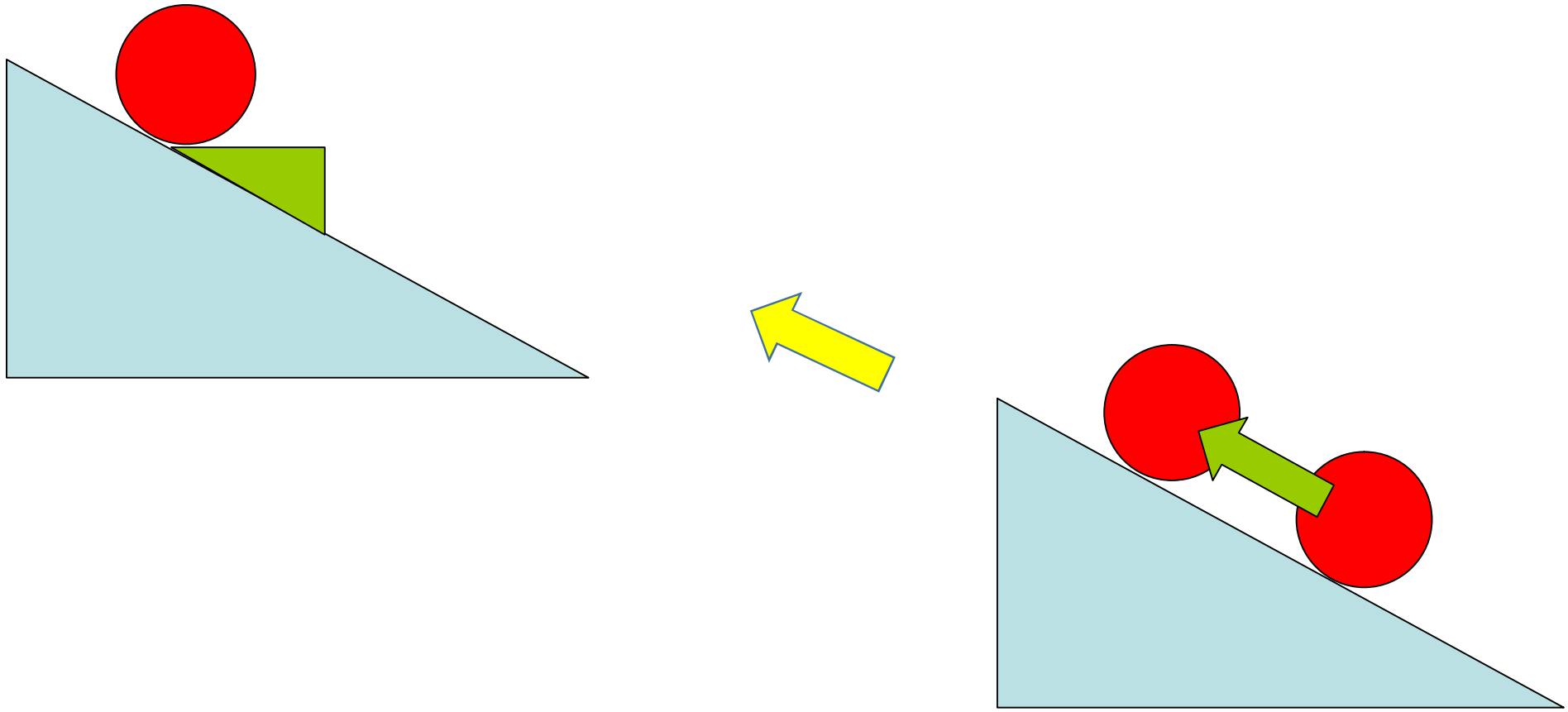
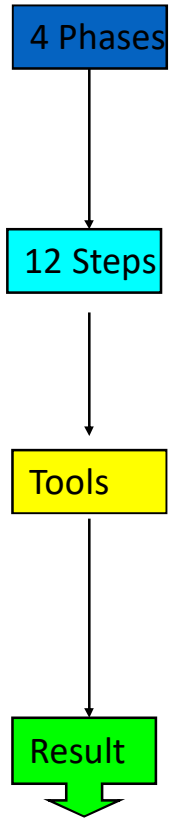
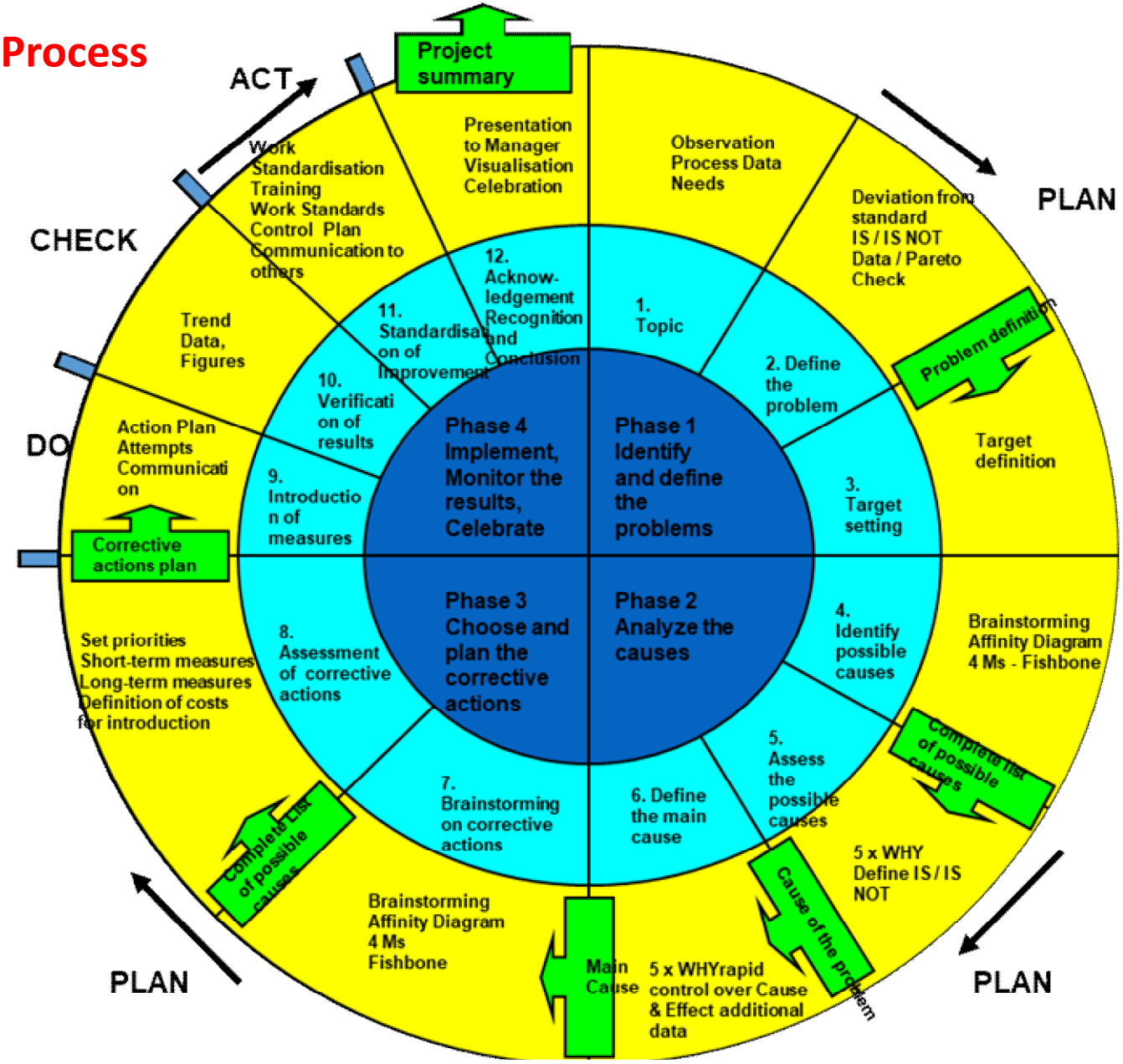
7) STANDARDIZATION AND SUSTAINABILITY



The Problem Solving Process (PDCA)





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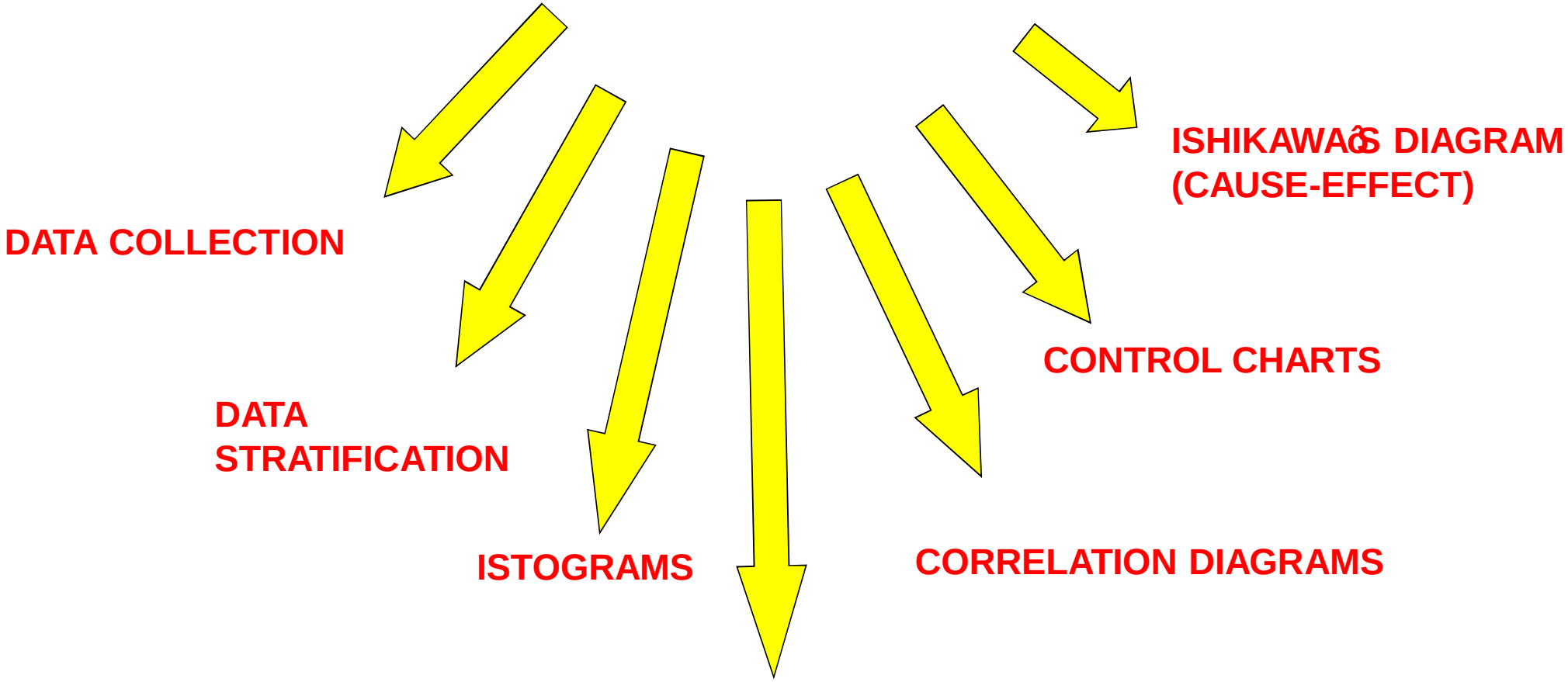
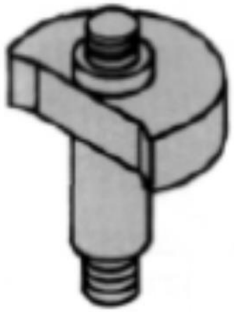
TECHNIQUES FOR THE PROBLEMS SOLUTION

THE SEVEN TOOLS



POKAYOKE



AVOID
POSSIBLE MISTAKES

POKAYOKE

WARNING ABOUT A POSSIBLE MISTAKES

1. .....
2. .....
3. .....
4. .....

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A 3

THIS IS THE ESSENCE OF THE LEAN THINKING:
INSTEAD OF A LONG REPORT,
A SYNTHETIC, CONDENSED REPORT IN A 3 SIZE

BASE PRINCIPLES:

- **FOCUS ON THE FEW IMPORTANT THINGS**
- **LEAN THINKING DISCIPLINE (SINTHESYS)**
- **EFFECTIVE COMMUNICATION**
- **TOOL FOR TEACHING AND CONTINOUS LEARNING**

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A 3

EXAMPLE

PROBLEM DEFINITION:
- What is actually the problem?
- What are the pertinent datas?
- What is the problem extension?
- Why is a problem for the company?

TARGETS:
Measurable description of what has to be changed, KPI, Time

CAUSE ANALYSIS:
- Problem
- Root Analysis
- 5 Whys
- Ishikawa's Diagram

ACTIONS:
- Temporary actions
- Long term actions

IMPLEMENTATION:
- WHAT: actions
- WHERE: places
- WHO: responsibles
- WHEN: Timing

FOLLOW-UP:
- State of the art
- Not yet solved problems
- Results report

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ONE POINT LESSON

EXAMPLE

WHAT WERE THE TARGETS?:
What did we want to get? Where did we want to be? What performance did we want to have?

10%

WHAT DID IT HAPPEN ACTUALLY?:
What targets did we achieve actually?
What has been actually done?

15%

WHY DID IT HAPPEN?:

- Why did we not reached the targets?
- What were the causes?
- Why do we have a gap between the target and the present situation?

25%

WHAT WILL WE DO NEXT TIME?:
List the lessons learned

50%

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AFFINITY DIAGRAMS

- **TOOL TO ORGANIZE INFORMATION AND REACH CONSENSUS**
- **STEPS:**
  - **CHOOSE THE PARTECIPANTS**
  - **PREPARE (POST-IT, FLIP CHART, PENSé .)**
  - **SET UP THE TOPICS**
  - **ASK THE PARTECIPANTS TO BRAINSTORM ON THE TOPICS, REPORTING THE IDEAS ON THE POST-IT**
  - **PUT THE POST-IT RANDOM ON THE BOARD**
  - **CLEAN UP AND COLLECT THE POST-IT BY AFFINITY**
  - **PRIORITIZE**

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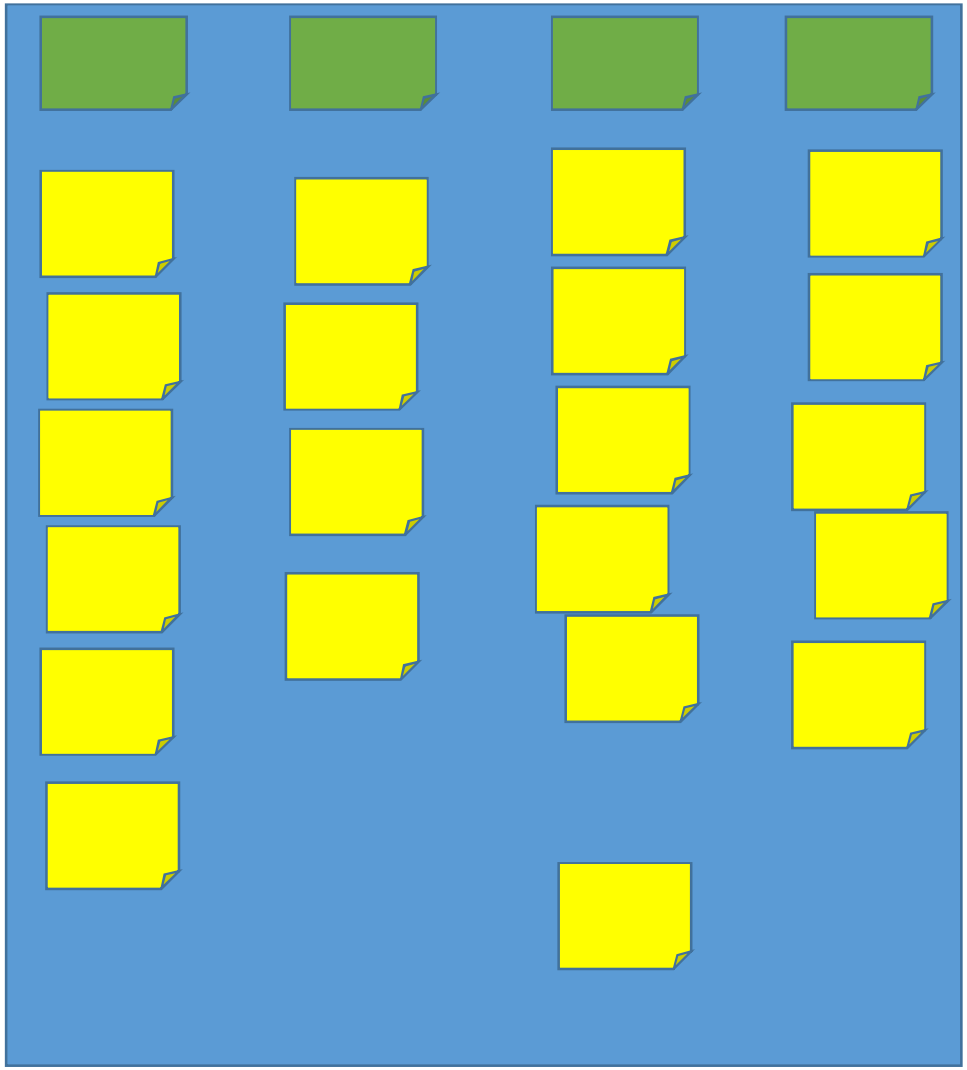
AFFINITY DIAGRAMS



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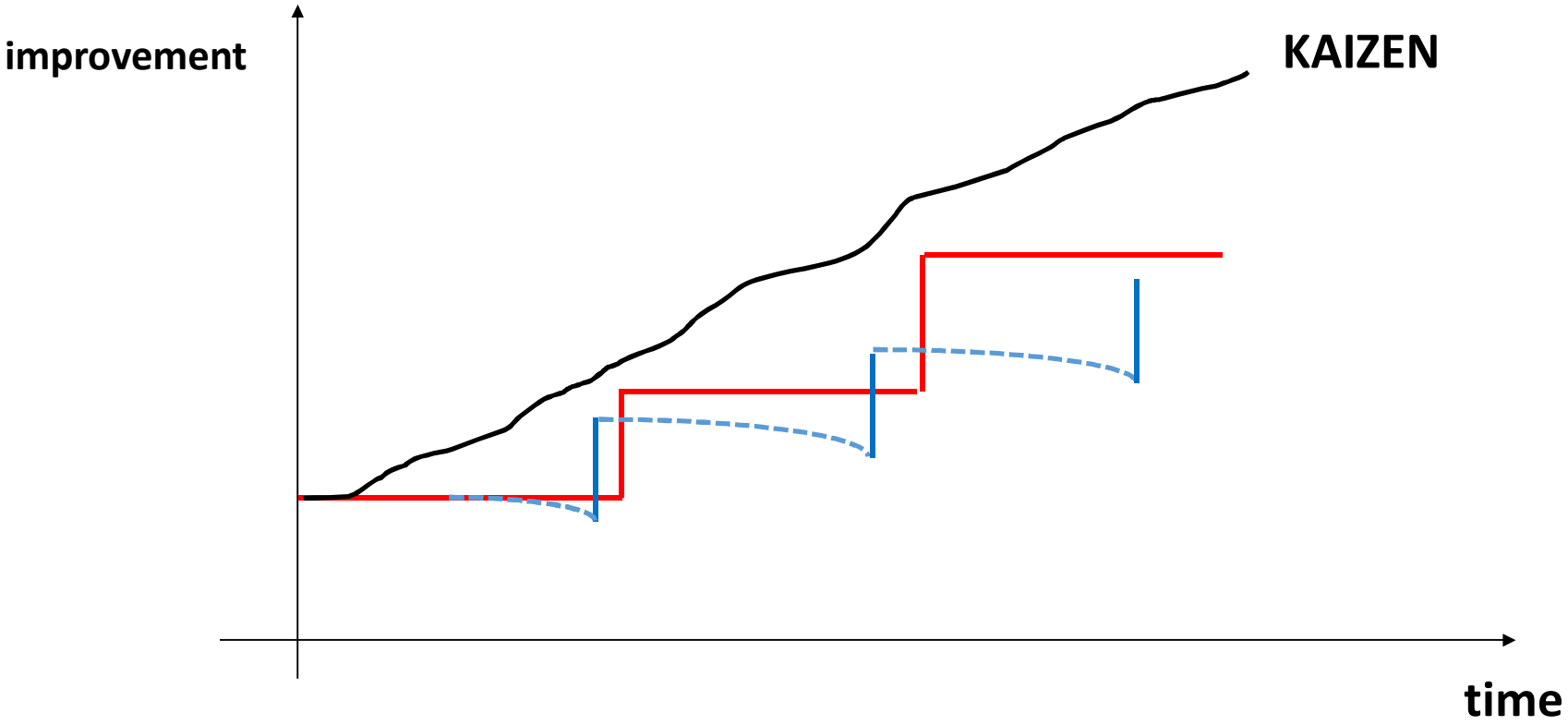
KAIKAKU



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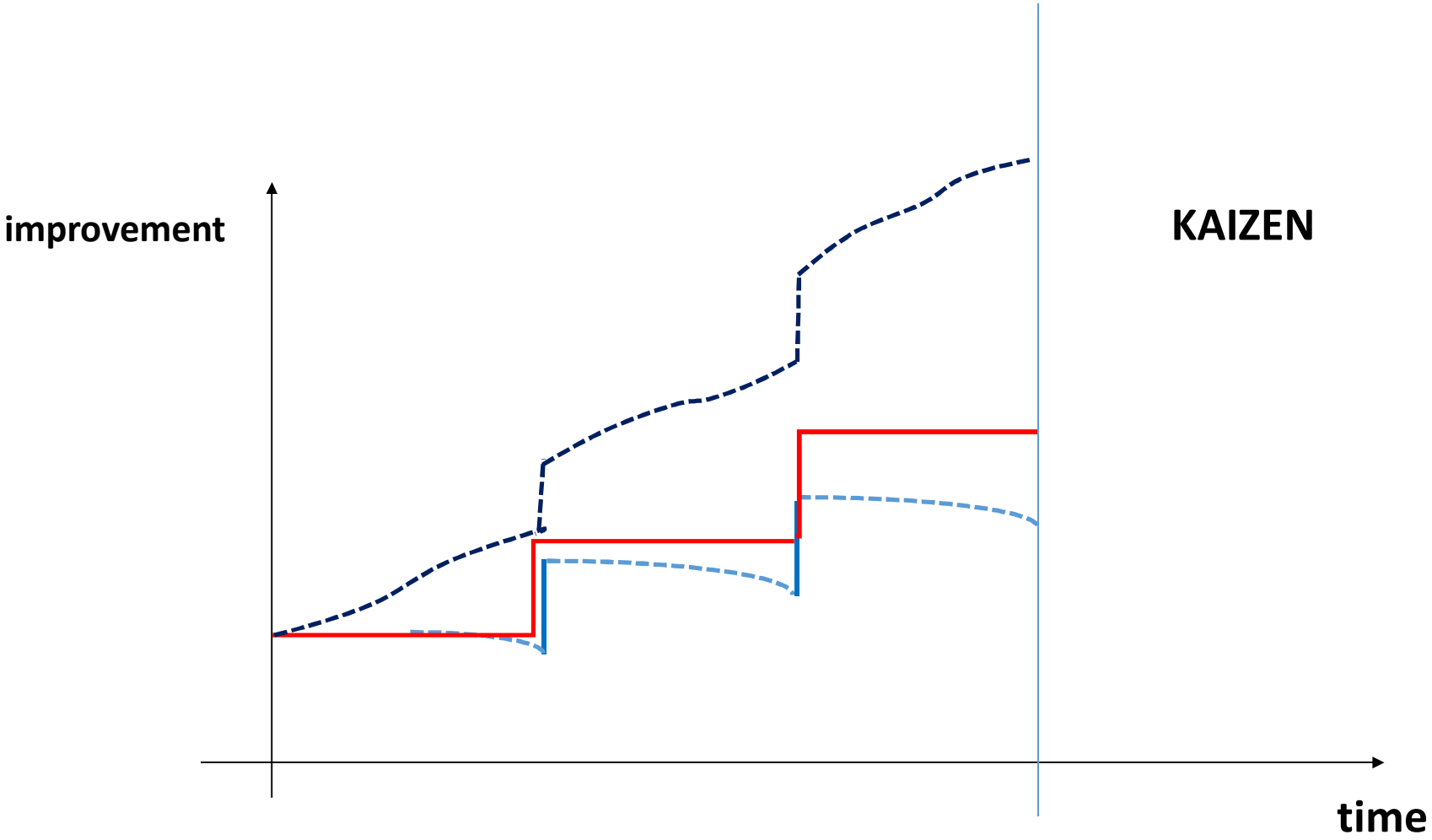
KAIKAKU



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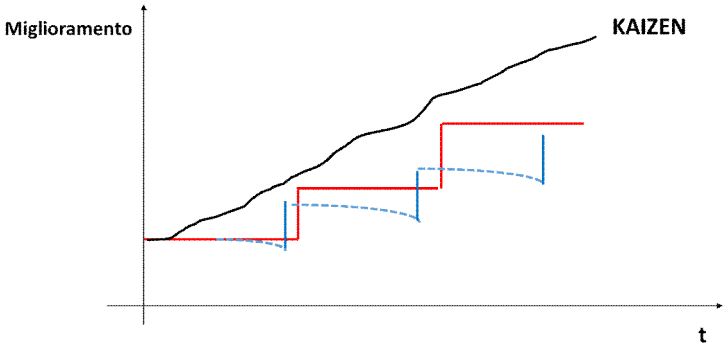

KAIKAKU:

- Concept: innovation, revolution
- Long time planning
- High investment
- Low involvement of the employees
- Big steps (IRREVERSIBLE)
- Unflexible Process (if you do not hit the target, you can not get the objectives)

KAIZEN:

- Concept: evolution
- Short term planning
- low level o zero investment
- High level cooperation with the employees
- Small step (POSSIBLE CHANGES)
- Continuous improvement by achieving objectives

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TECHNIQUES AND TOOLS					7 TOOLS	DATA COLLECTION SHEETS	
						STRATIFICATION	
						CORRELATION	
						PARETO'S DIAGRAM	
						ISTOGRAMS	
						CONTROL CHARTS	
						ISHIKAWA DIAGRAM	
					ONE POINT LESSON		
					A3	5 WHYS	
					KEY PERFORMANCE INDICATORS		
					5 S		
				YAMAZUMI	ANDON		FLASH MEETINGS
				TAKT TIME	VISUAL MANAGEMENT		GROUP WORK
			ERGONOMY	KANBAN	STANDARDIZATION		EMPOWERMENT
			TPM	KAIKAKU	PDCA		INVOLVEMENT
			SMED	JIT	POKAYOKE		AGREEMENT
		SPAGHETTI CHART	OEE	HEIJUNKA	KAIZEN		INFORMATION
	WASTES	LABOUR TIMES STUDY	ONE PIECE FLOW	FROM PUSH TO PULL	SIX SIGMA		COMMUNICATION
	HOSHIN KANRI	CURRENT VMS	FUTURE VSM	PULL	JIDOKA		MOTIVATION RESEARCH
PRINCIPLES	DEFINE THE VALUE	IDENTIFY THE VALUE FLOW	SET UP FLOW ACTIVITIES	MANUFACTURE PULLING THE PRODUCTION	RESEARCH PERFECTION		ATTENTION TO PEOPLE
FOCUS	CUSTOMER				QUALITY		EMPLOYEES

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LESSON LEARNT

- PROBLEM SOLVING IS THE BASE FOR KAIZEN
- THE TOOLS HELP THE WORKING GROUP TO RAZIONALIZE AND SPEED UP THE JOB
- KAIKAKU IS NECESSARY WHEN THERE IS A CHANGE OF TECHNOLOGY

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SUMMARY

- MANY COMPANIES START THE LEAN ADVENTURE, BUT FEW IMPLEMENT IT CORRECTLY
- KAIZEN
- PROBLEM SOLVING
- IMPORTANCE OF THE TOOLS
- PDCA
- STANDARD