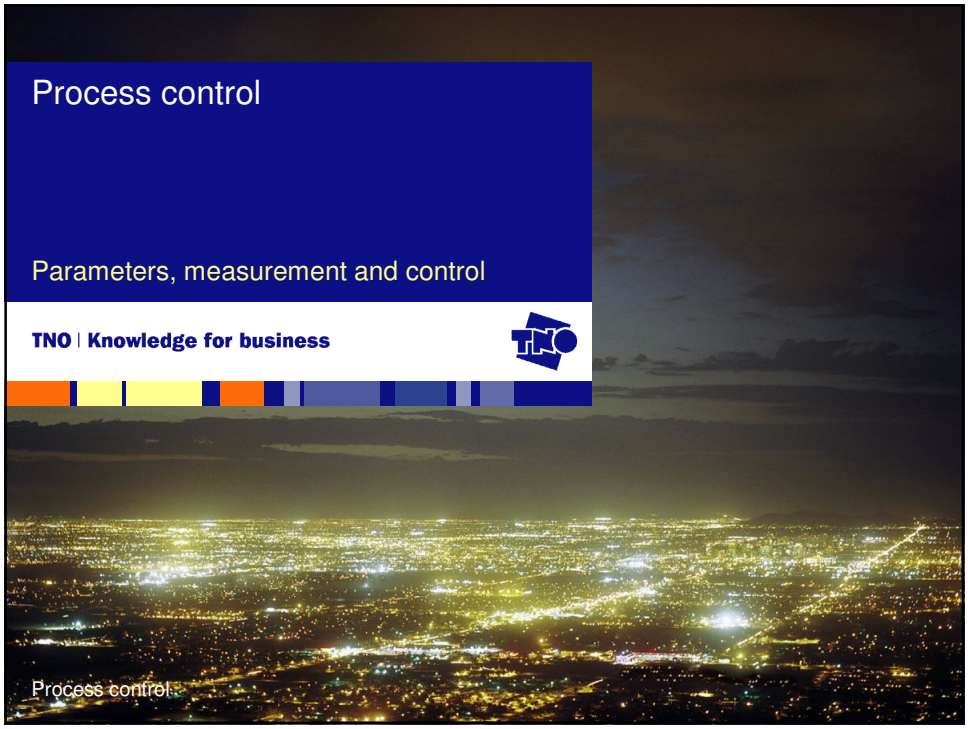


China, Zhou Dynasty (11th to eighth centuries B.C.) 周

- "Cottons and silks of which the quality and size are not up to the standards are not allowed to be sold on the market."
- Separate warp and weft standards for silk in the north and south because of differing weather and humidity.

Germany , Tuchshau ('showing of cloth',14th-century)

- Inspectors observed the entire manufacturing process starting at the loom, where warps were inspected.

Quality

Now:

- different grades of quality defined by final inspection
- sold at various prices

What is a good quality?

For instance: what is a perfect tomato?

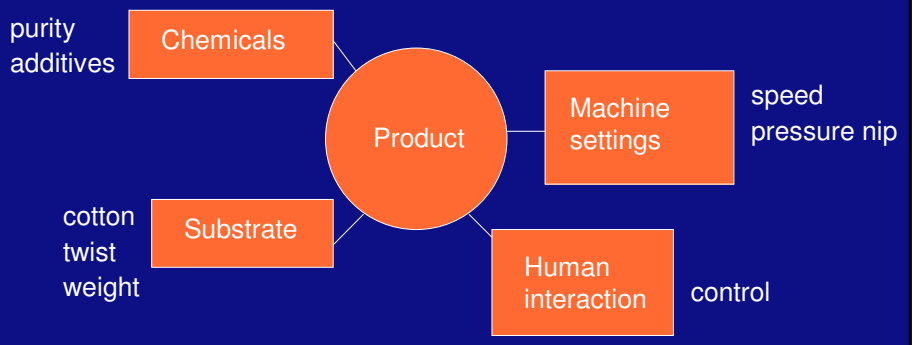
Tomato ketchup

- To make it more difficult

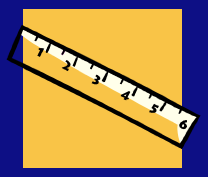
Tomatoes	&	Sugar, salt	=	Ketchup

Varying ingredients result in varying end product

Textile fabrics



Remedy



Add inspection and control to:

- the quality of raw materials and
- the production processes

Benefits

- first time right
- increased quality
- correct for substrate variations
- correct for chemical variations
- adequate water and energy consumption
- increased competitiveness

Possible process parameters

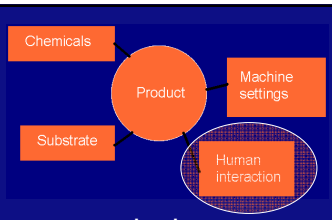
Consumption:
- water
- electricity
- wood
- steam

Machine settings:
- temperature
- fabric speed
- squeeze pressure
- tension

Fabric parameters:
- fabric weight
- width
- bow and skewness
- colour
- shrinkage

Chemicals:
- purity
- quality dyes

Human interaction



Detect errors in the production with cause analysis

Causes for reduced quality:
- technical causes
- operational and maintenance negligence
- poor raw material quality
- poor lay-out
- bad technology
- management causes
- employee de-motivation

Cause Analysis - Finding solutions

Discuss errors, faults or causes?

Advantages of causes:

Problems

- are linked to causes
- become manageable
- are talked over
- are measurable
- are solved
- will never come back

Method

Take one machine or process:

- Step 1: divide causes in
  - Machine
  - Material
  - Man
  - Method
- Step 2: Sort by →
- Step 3: Analyse
- Step 4: Remove cause
- Repeat step 3 and 4

Divide in (for instance)

- technical causes
- operational and maintenance negligence
- poor raw material quality
- poor lay-out
- bad technology
- management causes
- employee de-motivation

For instance causes Continuous Dyeing

- Wrinkles because uneven folding
- Temperature too low or too high
- Speed variations
- Stopping of the machine
- Fabric entangled in rollers
- Oil stains
- Condense stains
- Broken barrels
- Fabric too wet
- Not enough dye pickup because of wet fabric
- Sensor failure, air in analyser
- Too long in steam chamber because speed was too low
- Faulty pressure in squeezing the fabric
- Steam pressure too low

Cause analysis

Technical causes
Poor housekeeping:
Leaking taps, valves or flanges
Spillages
Overflowing tanks

Operational and maintenance negligence
Worn out machines
Unchecked water and air consumption;
Unnecessary running of equipment
Sub optimal loading and dosing
Lack of preventive maintenance
Adoption of avoidable process steps
Operation because of habits

Cause analysis

Poor raw material quality
Use of substandard cheap raw material
Lack of quality specification
Shortages of supply
Improper purchase management system
Wrong material selection
Improper storage
Poor process or equipment design
Mismatched capacity of equipment
Lack of information or design capacity

Poor lay-out
Unplanned/ad hoc expansion
Poor space utilisation plan
Bad material movement plan

Cause analysis

Tool: cause analysis
- technical causes
- operational and maintenance negligence
- poor raw material quality
- poor lay-out
- bad technology
- management causes
- employee de-motivation

Bad technology
Continuing with the same technology
despite product/raw material change
High cost of better technology
Lack of availability of trained manpower
Lack of information

Management causes
Increased dependence on casual or contract labour
Lack of formalised training system
Lack of training facilities
Job insecurity
Fear of losing trade secrets
Lack of availability of personnel
Under-staffing hence work over pressure

- Getting started
- Analysing the process steps
- Generating opportunities
- Selecting solutions
- Implementing solutions
- Sustaining Cleaner Production

Cause analysis

Employee de-motivation
Lack of recognition
Absence of reward/punishment system
Emphasis only on production, not on people
Lack of commitment and attention by top management

Analysis, removal

- Rank causes within divisions
- Eliminate first causes with shortest payback time
- Repeat
- Monitor that improvements are maintained

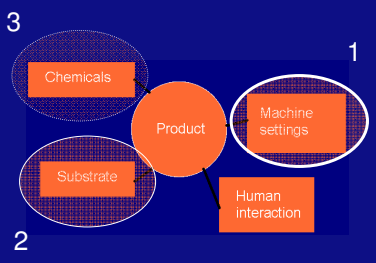
Tool: cause analysis
- technical causes
- operational and maintenance negligence
- poor raw material quality
- poor lay-out
- bad technology
- management causes
- employee de-motivation

Be aware of available management capacity

Poor raw material quality
- Use of substandard cheap raw material
- Lack of quality specification
- Shortages of supply
- Improper purchase management system
- Wrong material selection (2)
- Improper storage (1)
- Poor process or equipment design
- Mismatched capacity of equipment
- Lack of info on capabilities machine (3)

Process control leads to better defined quality

Process parameters
- identify
- measure
- control



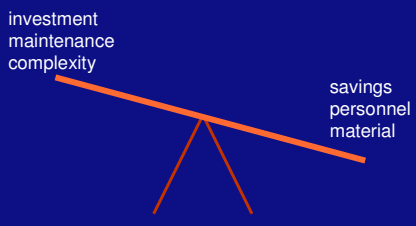
Make an inventory

Process parameters
- identify
- measure
- control

of what is measured:
- in the processes (in-line) and
- in the laboratory (off-line)

Ask yourself:

What will it bring if we collect more data?



Sensor evaluation

Process parameters
- identify
- measure
- control

- Necessity

  (quality increase)
- Availability

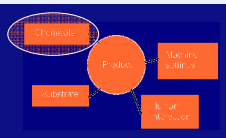
  (suppliers, is it possible)
- Feasibility

  (is it practical, machines, employees, infrastructure)
- Verifiable

  (can we measure the effect off-line)

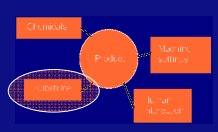
Off-line

Dye liquor control system

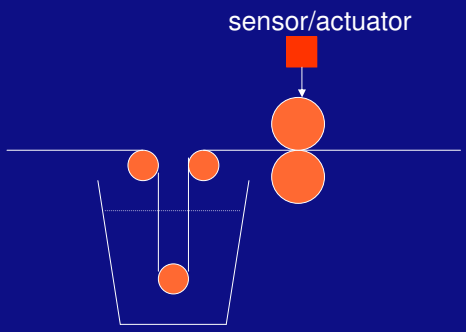


Material control

- pH
- residual analysis
- conductivity analysis

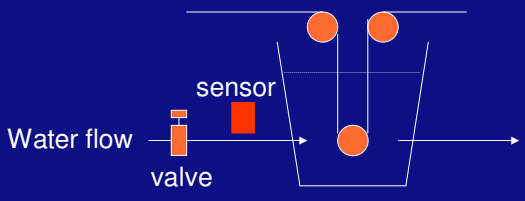


Sensor and actuators: machine settings



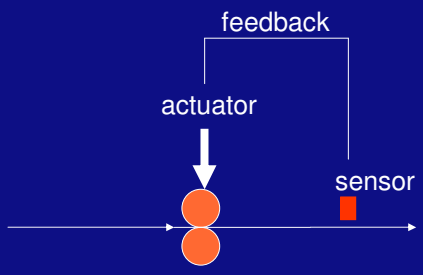
Applies to:
- pressure nip
- speed
- water level
- width burners

Sensor and actuators: process parameters



Applies to:
- temperature
- steam
- water flow
- dosing chemicals

Sensor and actuators: fabric quality



reliable product quality

Applies to:
- moisture
- fabric weight
- width
- bow and skewness
- color
- shrinkage

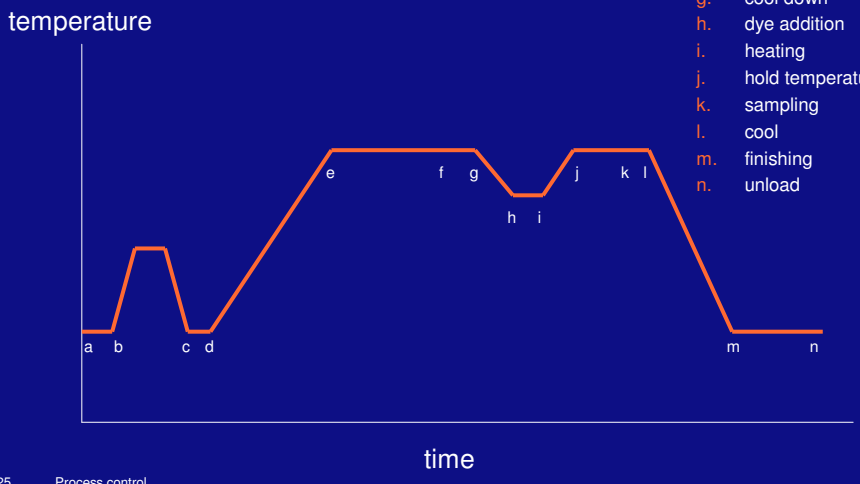
Data analysis

Process parameters
- identify
- measure
- control

Useful on different levels:

- management
  (production control, logistics)
- process control
  (machine control, down time, consumption)
- parameter control
  (sensor/actuator)

Dye control
uptake curve



a. load and fill
b. pretreatment
c. dye
d. heating
e. hold temperature
f. sampling
g. cool down
h. dye addition
i. heating
j. hold temperature
k. sampling
l. cool
m. finishing
n. unload

Package dye machine control

Sensors and actuators

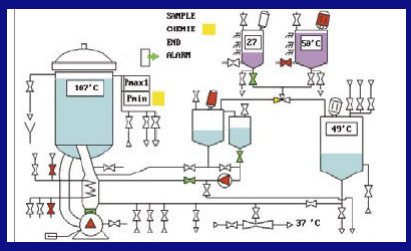
- Control of :
  - pressures,
  - times,
  - temperatures,
  - flows
- Inputs can be:
  - RTD temperature probes or
  - voltages,
  - currents,
  - pressures,
  - pulses,
  - etc. from other instrumentation

- important variables are displayed on the screens
- alarm conditions in graphical or text format
- alarms are also indicated by horns, lights
- diagnostic program (trouble shooting of mechanical components), causes of low dyeing efficiency or increased redyes

Package dye machine control

PLC controlled

- control for 1 to 12 kier machines
- networked to a supervisor computer for centralized:
  - procedure making,
  - status display and
  - reporting



PROCEDURE STEPS

- START - Beginning of dye cycle
- ADD - Add from makeup tanks
- FILL - Water addition at blend temperature
- RAMP - Controlled ramp rate to the set point
- HOLD - Timed hold in a state
- REVERSE - Changes the flow direction
- DRAIN - Drains until float switch inactive
- EXTRACT - Extracts water from the yarn
- ENDCYCLE - Last step in a procedure
- WASH - Wash with temperature control
- PREPARE - Notify drug room to add chemical plus level & temperature control
- SAMPLE - Notify operator to take a sample
- SUBROUTINE - A group of procedure steps

Package dye machine control

Range speed and quality report

Range Status

MICRO SERVICES GROUP TEST PLANT 1/5/00
RANGE SPEED AND QUALITY REPORT

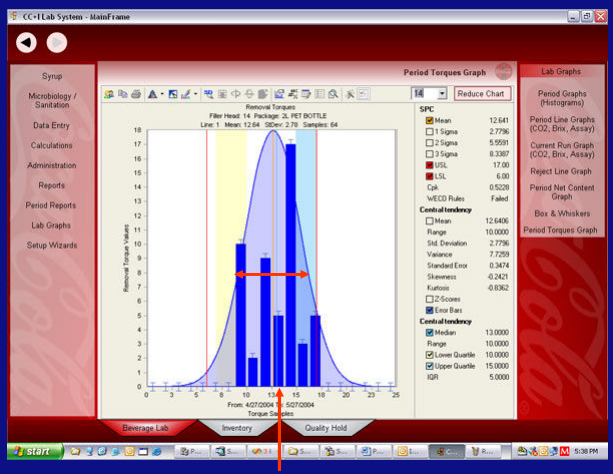
			TEMP1	TEMP2	TEMP3	TEMP4	TEMP5	TEMP6	TEMP7	TEMP8
DYE RANGE 1	RUNNING		Z1L	Z1R	Z2L	Z2R	ZONE 3	ZONE 4	Z5L	Z5R
LOT 3347683800	SETUP	15	175	210	210	210	210	225	225	215
ROLL 4321	SPEED	88	175	205	208	112	220	220	221	213
DYE RANGE 2	RUNNING		ZONE 1	ZONE2	Z3L	Z3R	ZONE 4	ZONE 5	Z6L	Z6R
LOT 3347683849	SETUP	11	160	175	175	175	175	200	215	250
ROLL 007	SPEED	105	175	175	175	175	175	175	175	175
DYE RANGE 3	PATCHING		Z1L	Z1R	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7
LOT 123456789012	SETUP	13	175	180	180	180	225	200	215	200
ROLL 6852	SPEED	10	175	175	175	175	175	175	175	175
DYE RANGE 4	RUNNING		Z1L	Z1R	Z2L	Z2R	ZONE 3	ZONE 4	Z5L	Z5R
LOT 4455009	SETUP	10	175	175	175	175	175	175	175	175
ROLL 9999	SPEED	68	175	175	175	175	175	175	175	175
DYE RANGE 5	WAITING FOR GOODS		Z1L	Z1R	Z2L	Z2R	ZONE 3	ZONE 4	Z5L	Z5R
LOT 0097362123	SETUP	14	180	210	210	210	210	225	225	200
ROLL 1040	SPEED	0	175	175	175	175	175	175	175	175

Statistical process control

- From
  - defect detection,
  - sorting,
  - situation resolution and
  - other firefighting activities
- To
  - continuous improvement and
  - prevention

How do we keep the variations in our process under control?

Histogram



- location of maximum (value)
- width of the Gauss curve (range)

Example: spinning

- Zellweger Uster, Switzerland started collecting data
- 1997, statistical information about twist statistics
  - yarn count,
  - strength,
  - elongation,
  - twist,
  - uniformity,
  - coefficient of friction and
  - hairiness

are now all regularly analyzed.

Relationship between yarn and fiber quality and the final fabric's quality is now better understood and managed

Continuous improvement
RDMAICSI cycle