D 57
COQ (cost of obtaining quality) approach

Objective

Objective of the module: Master the COQ approach (measure quality) to be able to:

- identify improvement actions
- increase the added value produced
- get ahead of the competition

1 COQ approach

1.1 History

There are many definitions of the word quality. Some examples:

- “conformance to requirements”, Philip Crosby
- “anything that can be improved”, Masaaki Imai
- “fitness for use”, Joseph Juran
- “the ability to satisfy the customer”, Kaoru Ishikawa
- “degree to which a set of inherent characteristics of an object fulfils requirements”, ISO 9000: 2015, § 3.6.2
- “the absence of defects”, Joseph Juran
- take pride in your work
- do it right the first time and all the time

True story

In the code of King Hammurabi of Babylon (1730 BC), we find one of the oldest written traces of quality requirements:

- *if an architect builds a house and one of the walls falls, this architect will consolidate this wall at his own expense*
- *if an architect builds a house and the house collapses and the master of the house is killed, that architect is liable to death*

To be a step ahead of your competitors, managing quality is not always enough. However, knowing your quality-related costs and succeeding in reducing them is often a great advantage.

Cost control and quality control are two sides of the same coin. Kaoru Ishikawa

Quality control involves the evaluation of costs and waste. The simplest way to measure quality (an abstract notion for some) is to find out how much non-quality costs us.

If you can't measure it, you can't control it. Peter Drucker

One of the first to use the expression "Total Quality Control" and to classify the costs of quality was Armand Feigenbaum in the 1950s. He successfully tackled the myth that getting better quality comes with very high costs. He developed the concept of the phantom (hidden) factory that corrects the errors of the official factory (up to 40% of production). Feigenbaum divided the operational costs of quality into two main areas, each with two segments:

- control:
  - prevention
  - detection
- failure:
  - internal
  - external

One of the founding fathers of quality, Joseph Juran, speaks of the cost of poor quality or costs attributable to poor quality. He thinks these costs are "gold in the mine" and just waiting to be extracted. Juran classifies costs into four categories:

- internal failures
- external failures
- quality measurement
- prevention

Another founding father of quality, Philip Crosby, in his best-known book "*Quality is Free*", devotes a chapter to the cost of quality (Cost of quality, or COQ). He divides the COQ into costs of:

- prevention
- assessment and
- failures

In 1986, AFNOR published a documentation booklet ("FD X50-126 - Guide to the evaluation of costs resulting from non-quality") in which the classification of these costs is as follows:

- internal anomalies
- external anomalies
- detection
- prevention

According to James Harrington, direct poor-quality costs are divided into three elements:

- controllable costs
- resulting costs and
- equipment costs

Harrington includes in the controllable costs the costs of prevention and evaluation, while the costs of internal error and external error are part of the resulting costs. The result is an impressive list of 364 cost types!

Later, in 1999, AFNOR published the documentation booklet FD X50-180 "Contribution defaults - Defaults connected to non-quality of work in the creation and use of add-value". The logic of this approach is based on the path shown in figure 1-1:

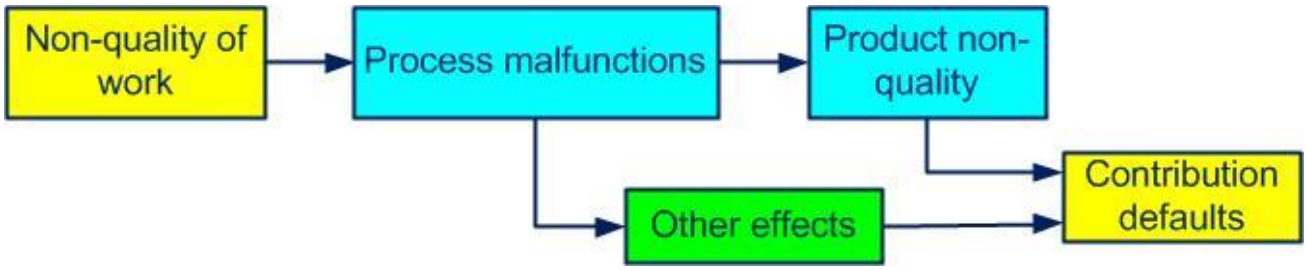


Figure 1-1. Contribution defaults

Clause 4 bears the revealing title: "How to improve the performance of the organization?" One of the answers is in the efforts to reduce the 20 contribution defaults identified and classified in three categories:

- defects in the creation of added value by loss of potential turnover
- defects in the creation of added value by excessive consumption from third parties
- defects in the use of added value

Another representation is to divide the costs of obtaining quality into visible and hidden costs (cf. figure 1-2).

Figure 1-2. The cost iceberg

Authors speak of direct costs and indirect costs, of productive and unproductive costs and also of costs relating to quality and non-quality. Some costs are sometimes difficult to categorize such as:

- losses:
  - of market
  - of customers
  - of reputation
- missed opportunities
- stock shortages
- excessive inventory
- overconsumption:
  - of energy
  - of materials
- absenteeism
- work accident

Our preference is to refer to the costs of obtaining quality using the acronym COQ and classification in four categories:

- prevention
- detection
- internal nonconformities and
- external nonconformities

1.2 Benefits

It is not by chance that the COQ is named a strategic tool. Controlling the costs of obtaining quality allows us to:

- identify and measure the cost of waste
- eliminate waste
- improve internal communication:
  - raise staff awareness and accountability
  - make quality quantifiable and understandable
- measure the success of the continual improvement process
- analyze the efficiency of the processes
- make decisions based on indisputable facts
- set priorities knowingly
- promote preventive measures
- achieve unsuspected savings
- increase profits
- better understand the financial results
- be one step ahead of the competition and ultimately
- satisfy customers even better

One of the requirements of participants in the automotive industry chain is the regular evaluation of the costs of non-quality (ISO/TS 16 949, 5.6.1.1).

However the COQ **is not**:

- an approach to eradicate all costs related to quality
- a short-term project
- a search for the culprit for the costs
- use of questionable data

As shown in figure 1-3, the costs of nonconformities increase on a logarithmic scale with respect to the stage of their discovery. Controlling costs means anticipating problems as early as possible (managing upstream).

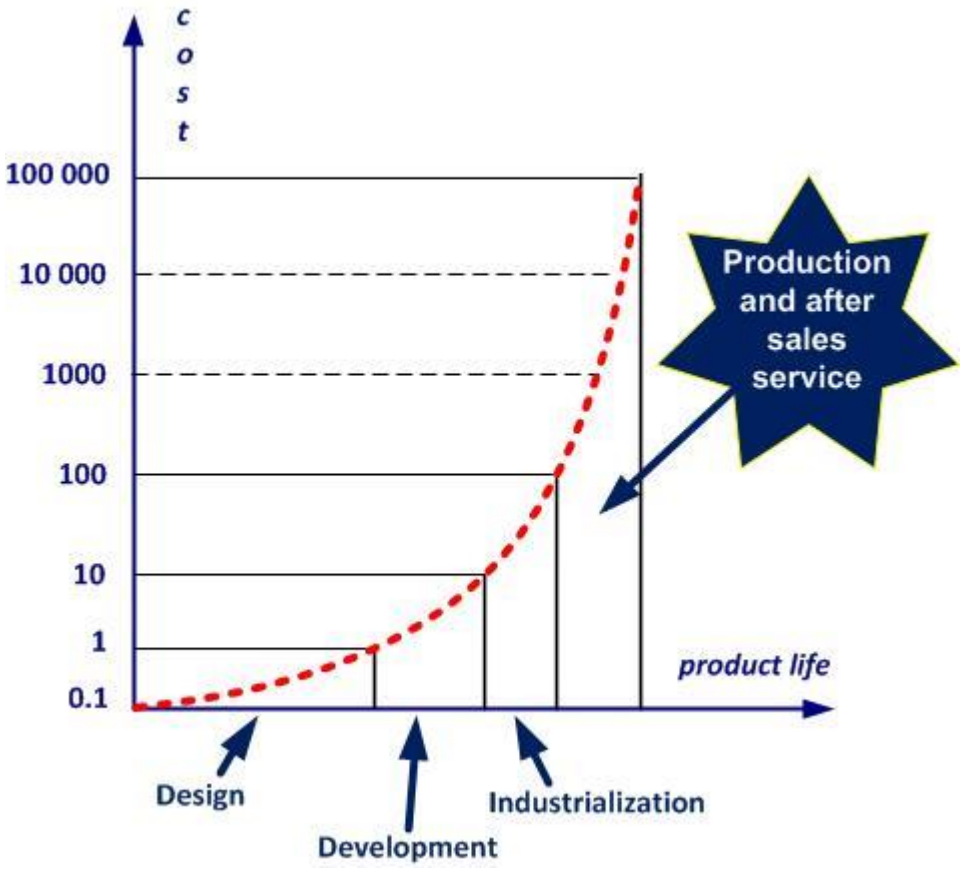


Figure 1-3. The cost of nonconformities versus product life

1.3 Steps

The prerequisites for the COQ approach are:

- total top management involvement
- the owner of the COQ process is named
- an inventory is carried out
- a study of what the competition is doing (benchmarking) is carried out
- a shared desire for continual improvement is in place
- the staff suggestion system is well established

The implementation of the approach to controlling the costs of obtaining quality (COQ) goes through a few stages (cf. figure 1-4).

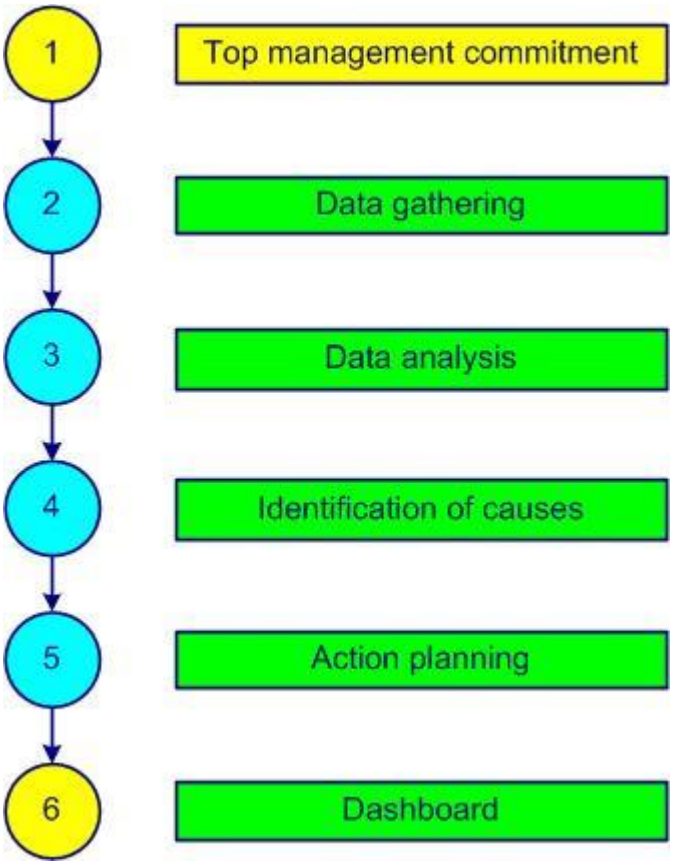


Figure 1-4. COQ steps

Step 1 is the (firm) commitment of top management who is fully involved in the COQ process. Top management is the main client of the results of the COQ and its active and regular participation in meetings is absolutely essential. The field of application (entire company, subsidiary, workshop, department, process), the COQ procedure and the cost calculation method are established. The COQ owner is appointed. Objectives are set.

Step 2, data gathering, happens during the COQ meeting. The costs of all departments are established before and are now presented, commented on and recorded.

Step 3 is the time to analyze the data, to seek the optimum of the COQ, and classify the costs by priority (Pareto chart).

Step 4 is the activity of identifying the root causes of the most significant costs (5 W method, Ishikawa diagram).

Step 5 consists of planning actions to reduce costs, appointing those responsible and setting deadlines.

Step 6 is updating the COQ indicators in the dashboard.

1.4 PDCA cycle

The PDCA cycle, also called the Deming cycle, applies to the control of any process. PDCA (Plan, Do, Check, Act) cycles are a universal basis for continual improvement (cf. figure 1-5).

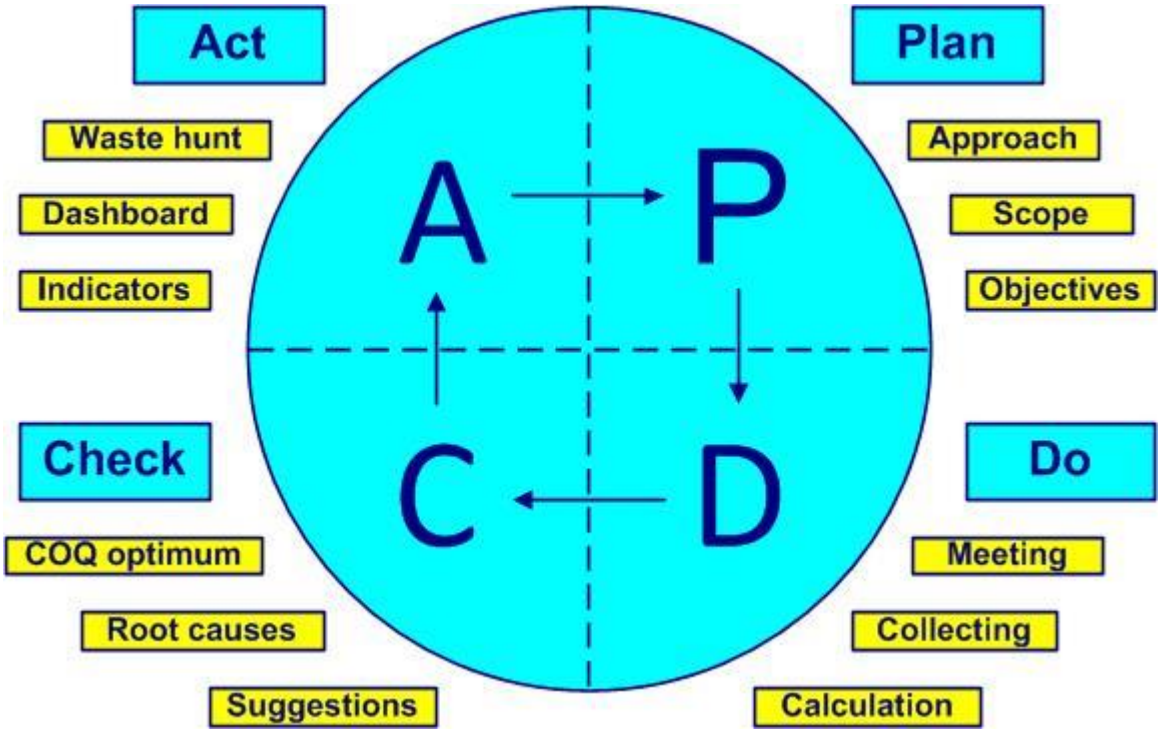


Figure 1-5. The Deming cycle

- Plan – define and establish the approach, the role of top management, the scope, the objectives, the actions
- Do – organize the COQ meeting, data collection, cost calculation
- Check – check objectives, find COQ optimum, review suggestions, look for root causes
- Act – adjust, adapt, react, update the dashboard, disseminate indicators, fight against waste

1.5 Top management role

When you sweep the stairs, you start at the top. Romanian proverb

The total commitment of top management to the success of the cost control process is essential.

For this, top management does not divide its responsibilities because divided responsibility means that no one is responsible.

Responsibility cannot be shared. Robert Heinlein

Top management is the essential facilitator of the COQ process (cf. figure 1-6).

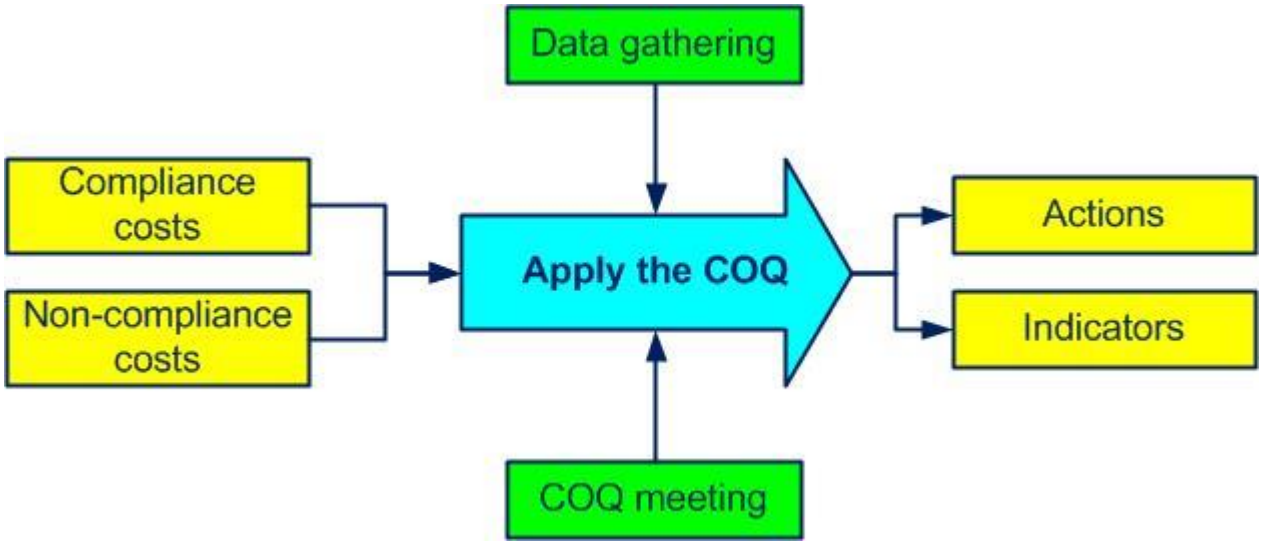


Figure 1-6. The process Apply the COQ

To obtain the success of the COQ approach, top management ensures the necessary conditions:

- the COQ principles and categories are understood and accepted by all (successful internal communication)
- the COQ procedure is updated and strictly applied (cf. annex 01)
- all departments regularly collect information on the various costs
- staff become aware of the cost of different nonconformities
- annual COQ objectives are set
- the COQ indicators are:
  - established
  - measured
  - followed and
  - illustrated (dashboard)
- action plans are implemented and monitored

The language of top management is dollars. Joseph Juran

To be understood by top management, the best way is to speak their language: in euros!

The COQ approach aims to improve quality. This improvement generates a reduction in costs, which causes a drop in prices, which leads to an increase in market share, which ensures a high return on investment, which allows a reduction in costs, and so on (cf. figure 1- 7):

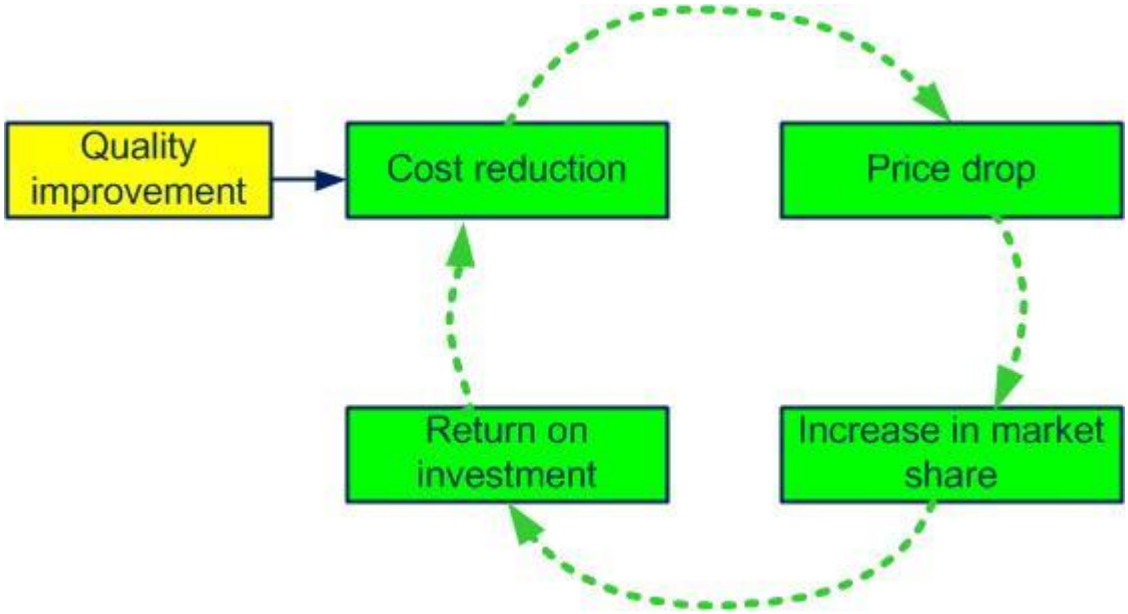


Figure 1-7. The COQ approach

Some examples of objectives of the COQ approach:

- identify the most significant cost reduction opportunities
- implement preventive actions
- establish and distribute COQ indicators
- follow the indicators
- educate staff
- invest in prevention
- improve internal communication

Do not forget that some damage (sometimes, alas, very significant) cannot be quantified directly. For example:

- customer disappointment
- shortfall
- loss of prestige (bad image)


Minute of relaxation. Cf. joke “Lack of communication”

2 Terms and definitions

2.1 Definitions

The beginning of wisdom is the definition of terms. Socrates

5 M: *Mother nature, Material, Method, Manpower, Machine (Fishbone or Ishikawa diagram)*
5 W: *five times Why?*
Anomaly*: variation compared to what is expected*
AV: added value
CC*: compliance cost*
Conformity: *fulfillment of a specified requirement*
Control*: ensure compliance with the specified criteria*
COQ: *cost of obtaining quality*
Corrective action: *action to eliminate the causes of nonconformity or any other undesirable event and to prevent their recurrence*
Curative action*: action to eliminate a detected nonconformity*
Customer satisfaction: *the top priority objective of every management system*
Customer: *the one who receives a product*
Defect: *nonconformity related to a specified use*
Dysfunction: *deviation in the ability of a functional unit to perform a specified function*
Effectiveness: *capacity to perform planned activities with minimum effort*
Efficiency: *financial relationship between achieved results and resources used*
ENC*: external nonconformity*
Failure*: variation of aptitude of a functional unit to satisfy a specified function*
FMEA*: Failure Mode and Effects Analysis*
Gemba: *from Japanese, real place, in the field*
INC*: internal nonconformity*
Indicator: *value of a parameter, associated with an objective, allowing the objective measure of its effectiveness*
Interested party: *person, group or organization affected by the impacts from a company*
ISO: *International Organization for Standardization*
Kaizen: *from Japanese, kai = change and zen = good (for the better, better), Kaizen = continual improvement*
Management system: *set of processes allowing objectives to be achieved*
Muda: *from Japanese, waste*
Mura: *from Japanese, irregularity*
Muri: *from Japanese, difficulty*
NCC*: non-compliance cost*
Nonconformity: *non-fulfillment of a specified requirement*
Non-quality: *gap between expected quality and perceived quality*
Organization: *a structure that satisfies a need*
Poka-Yoké: *system allowing the prevention of errors by eliminating the human factor (fail safe device)*
PPAP: *Production Part Approval Process*
Preventive action*: action to eliminate the potential causes of nonconformity or any other undesirable event and to prevent their appearance*
Problem: *gap that must be reduced to obtain a result*
Process: *activities that transform input into output*
Product (or service): *any result of a process or activity*
QCD: *Quality, Cost, Delay*
Quality management: *activities allowing the control of an organization with regard to quality*
Quality: *ability to meet requirements*
Requirement: *implicit or explicit need or expectation*

Safety: *absence of unacceptable risk*
Scrap: *treatment of an unrecoverable product*
SMED: *Single Minute Exchange of Die*
SPC: *Statistical Process Control*
Supplier: *the one who procures a product*
Top management: *group or persons in charge of the organizational control at the highest level*
TQC: *Total Quality Control*
Waste: *anything that adds cost but no value*
WWWWHHW: *Who, What, Where, When, How, How much, Why*

In the terminology used, do not confuse:

- anomaly, defect, dysfunction, failure, nonconformity, reject and waste:
  - an anomaly is a deviation from what is expected
  - a defect is the non-fulfillment of a requirement related to an intended use
  - a dysfunction is a degraded function that can lead to a failure
  - a failure is when a function has become unfit
  - nonconformity is the non-fulfillment of a requirement in production
  - a reject is a nonconforming product that will be destroyed
  - waste is when there are added costs but no value
- control and optimize
  - to control is to meet the objectives
  - to optimize is to search for the best possible results
- customer, external provider and subcontractor
  - a customer receives a product
  - an external provider provides a product on which specific work is done
  - a subcontractor provides a service or product on which specific work is done
- effectiveness and efficiency
  - effectiveness is the level of achievement of planned results
  - efficiency is the ratio between results and resources
- objective and indicator
  - an objective is a sought after commitment
  - an indicator is the information on the difference between the pre-set objective and the achieved result
- process, procedure, product, activity and task
  - a process is how we satisfy the customer using people to achieve the objectives
  - a procedure is the description of how we should conform to the rules
  - a product is the result of a process
  - an activity is a set of tasks
  - a task is a sequence of simple operations

Remark: the customer can also be the user, the beneficiary, the trigger, the ordering party or the consumer.

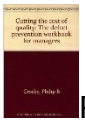
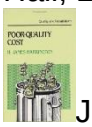
For other definitions, comments, explanations and interpretations that you don't find in this module and in annex 06, you can consult: 

- ISO Online Browsing platform (OBP)
- IEC Electropedia

2.2 Books and references

When I think of all the books still left for me to read, I am certain of further happiness. Jules Renard

Books for further reading on COQ approach:

-  Armand V. Feigenbaum, Total Quality Control, McGraw-Hill, 1951
-  Philip B. Crosby, Cutting the Cost of Quality; the defect prevention workbook for managers, Industrial Education Institute, 1967
-  Philip B. Crosby, Quality is free; the Art of Making Quality Certain, McGraw-Hill, 1979
-  Kaoru Ishikawa, What is Total Quality Control, The Japanese Way, Prentice-Hall, 1981
-  James H. Harrington, Poor-Quality Cost, Dekker, 1987
-  Masaaki Imai, GEMBA KAIZEN, A Commonsense Low-Cost Approach to Management, McGraw-Hill, 1997
- IATF 16949, Technical Specification - Quality management system requirements for automotive production and relevant service parts organisations, IATF, 2016
- ISO 10014, Quality management systems — Managing an organization for quality results — Guidance for realizing financial and economic benefits, ISO, 2021

Minute of relaxation. Paganini's violin concert performed with facial expressions.

3 Process approach

If you cannot describe what you are doing as a process, you do not know what you're doing. Edwards Deming

3.1 Process

The word process comes from the Latin root *procedere* = go, development, progress (*Pro* = forward, *cedere* = go). Each process transforms inputs into outputs, creating added value and potential nuisances.

A process has three basic elements: inputs, activities and outputs. 

A process can be very complex (launch a rocket) or relatively simple (audit a product). A process is:

- repeatable
- foreseeable
- measurable
- definable
- dependent on its context
- responsible for its external providers

A process is, among other things, determined by its:

- title and type
- purpose (why?)
- beneficiary (for whom?)
- scope and activities
- initiators
- documented information
- inputs
- outputs (intentional and not intentional)
- restraints
- people
- material resources
- objectives and indicators
- person in charge (owner) and actors (participants)
- means of inspection (monitoring, measurement)
- mapping
- interaction with other processes
- risks and potential deviations
- opportunities for continual improvement

A process review is conducted periodically by the process owner (cf. annex 02). 

Review: *a survey of a file, product or process so as to verify if pre-set objectives are achieved*

The components of a process are shown in figure 3-1: 

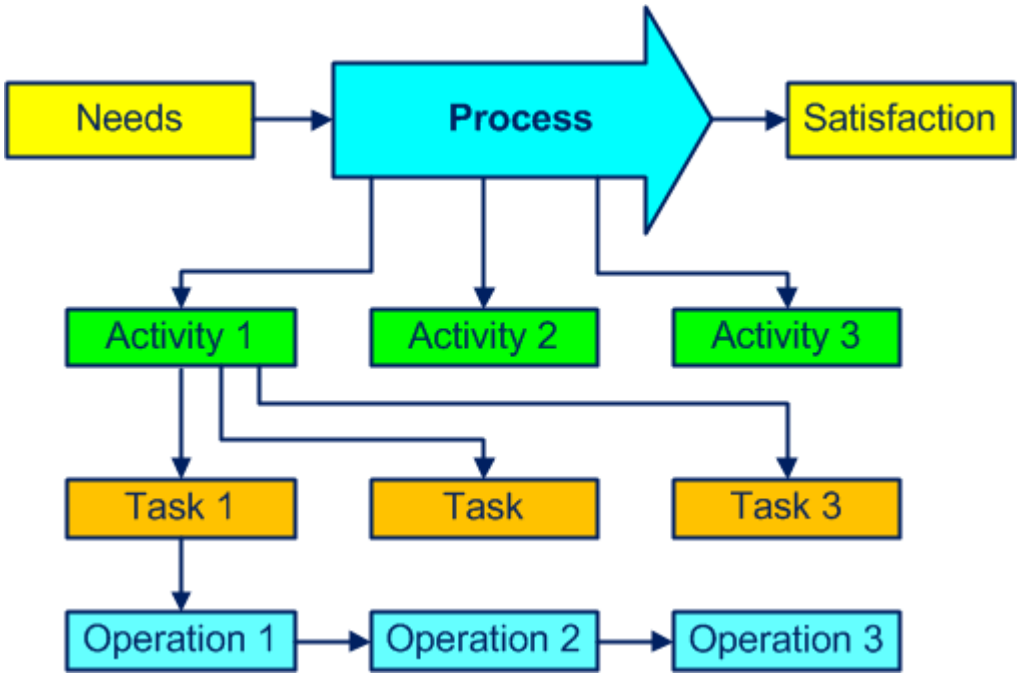


Figure 3-1. Components of a process

Figure 3-2 shows an example that helps to answer some questions:

- which materials, which documents, which tooling? (inputs)
- which title, what objective, which activities, requirements, constraints? (process)
- which products, which documents? (outputs)
- how, which inspections? (methods)
- what is the level of performance? (indicators)
- who, with what competence? (people)
- with what, which machines, which equipment? (material resources)

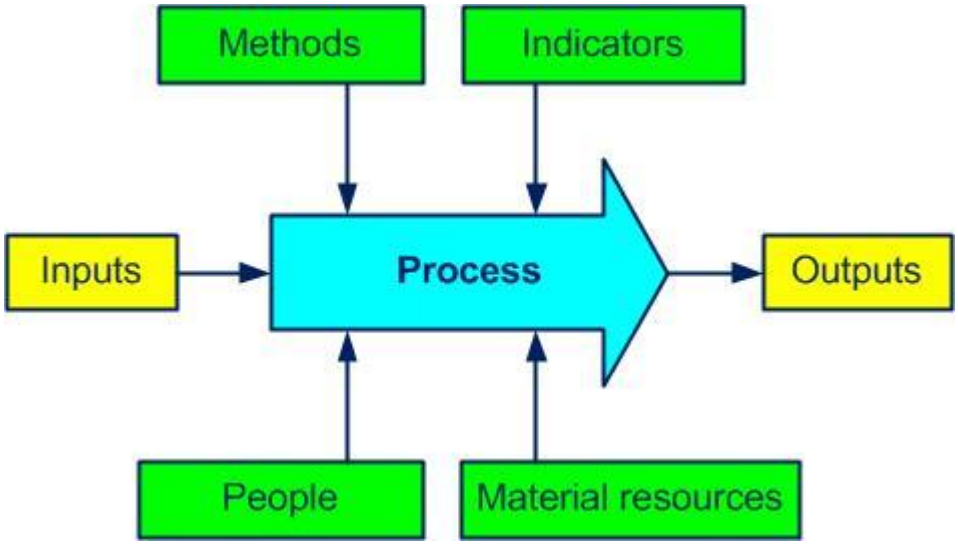


Figure 3-2. Some elements of a process

Often the output of a process is the input of the next process.

You can find some examples of process sheets in the document pack D 02 and a list of processes in annex 03.

Any organization (company) can be considered as a macro process, with its purpose, its inputs (customer needs and expectations) and its outputs (products/services to meet customer requirements).

Our preference is to identify a process using a verb (buy, produce, sell) instead of a noun (purchases, production, sales) to differentiate the process from the company's department or documented information to maintain and recall the purpose of the process.

The processes are (as we shall see in the following paragraphs) of management, realization and support types. Do not attach too much importance to process categorizing (sometimes it's very relative) but ensure that all the company's activities at least fall into one process.

3.1.1 Management processes

Management processes are also known as piloting, decision, key or major processes. They take part in the overall organization and include elaboration of the policy, deployment of the objectives and all needed checks. They are the glue holding together all of the realization and support processes. 

The following processes can be part of this family:

- develop strategy
- address risks
- develop policy
- deploy objectives
- establish process ownership
- improve
- conduct an audit
- communicate
- plan the QMS
- acquire and manage resources
- conduct management review
- measure customer satisfaction
- negotiate contract
- analyze data

3.1.2 Realization processes

The realization (operational) processes are related to the product, increase the added value and contribute directly to customer satisfaction. 

They are mainly:

- design and develop
- purchase components
- sell products
- produce
- inspect production
- maintain equipment
- implement traceability
- receive, store and deliver
- control nonconformities

- implement preventive and corrective actions

3.1.3 Support processes

The support processes provide the resources necessary for the proper functioning of all other processes. They are not directly related to a contribution of the product's added value but are still essential.

The support processes are often:

- control documentation
- provide information
- maintain infrastructure
- provide training
- manage inspection means
- keep accountability
- manage staff

3.2 Process mapping

Par excellence process “mapping” is a multidisciplinary work. This is not a formal requirement of either ISO 9001 or other ISO standards but is always welcome.

The three types of processes and some interactions are shown in figure 3-3.

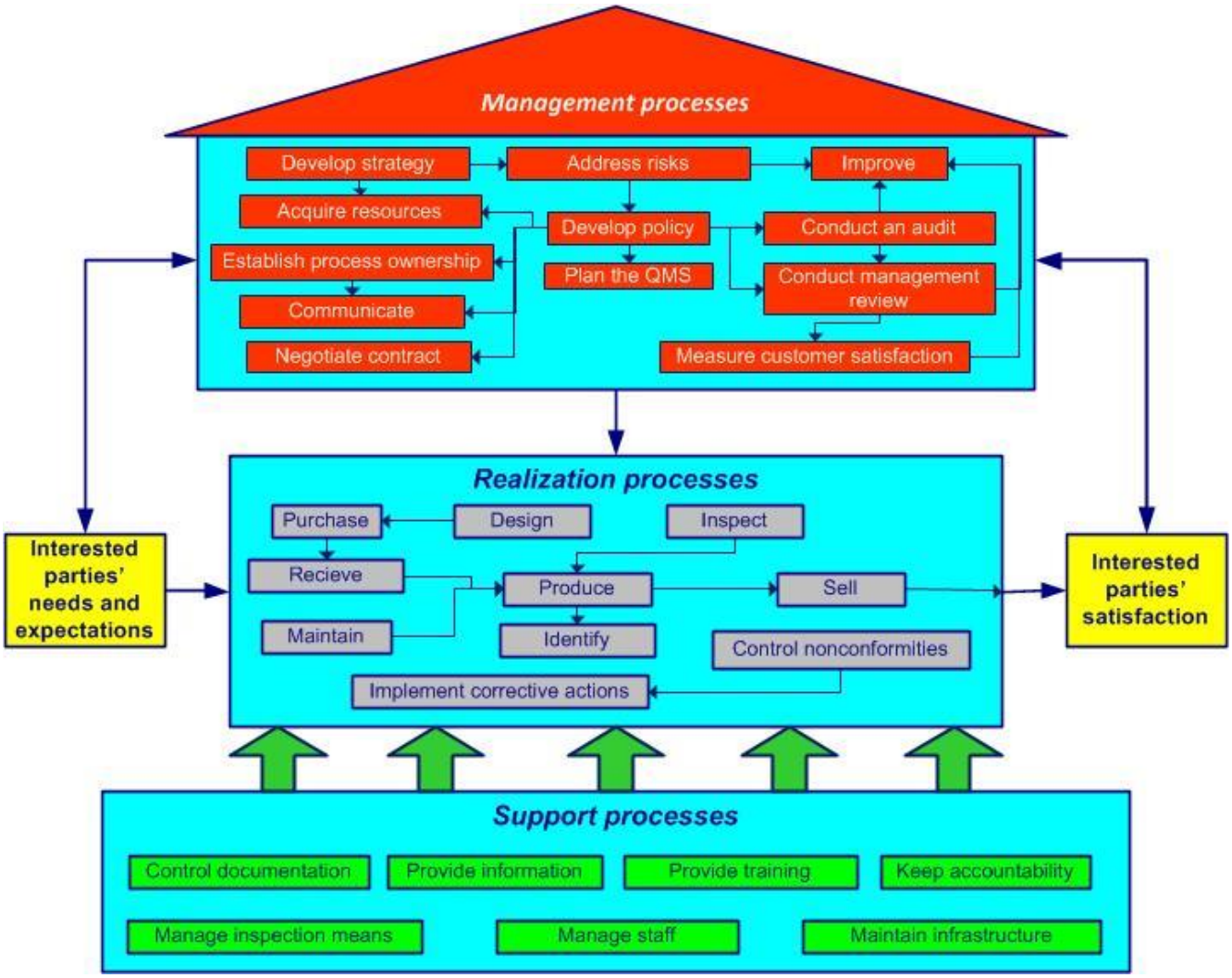


Figure 3-3. The process house

In the outputs, do not underestimate unwanted products such as rubbish, pollution and rejects.

Mapping, among other things, allows you to:

- obtain a global vision of the company
- identify the beneficiaries (customers), flows and interactions
- define rules (simple) for communication between processes

To obtain a clearer picture, you can simplify by using a total of about 15 core processes. A core process can contain several sub-processes: for example, the process “develop the QMS” can involve: 

- develop strategy
- develop policy
- address risks
- plan the QMS
- acquire resources
- establish process ownership
- improve

3.3 Process approach

The process approach contributes enormously to the efficient management of the company (cf. annex 21). Some benefits: 

- obtain a global vision of the company
- identify and manage responsibilities and resources
- achieve effective management of the company based on process indicators
- manage the risks that could influence the objectives

Process approach: *management by the processes to better satisfy customers, improve the effectiveness of all processes and increase global efficiency*

When the process approach is integrated during the development, implementation and continual improvement of a quality management system, it allows one to achieve objectives that are related to customer satisfaction, as is shown in figure 3-4.

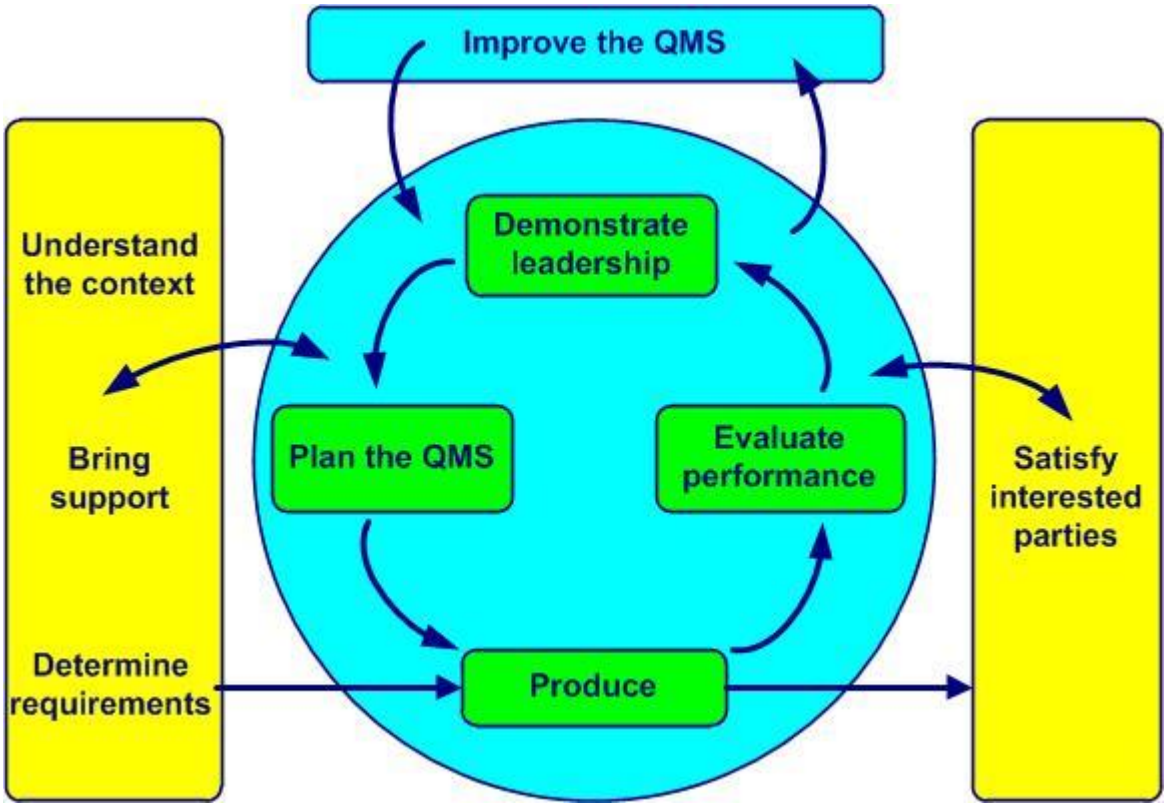


Figure 3-4. Model of a QMS based on the process approach and continual improvement

The process approach:

- emphasizes the importance of:
  - understanding and complying with customer requirements
  - prevention so as to react to unwanted elements such as:
    - customer returns
    - waste
  - measuring process performance, effectiveness and efficiency
  - permanently improving objectives based on pertinent measurements
  - process added value
- relies on:
  - methodical identification
  - interactions
  - the sequence and
  - process management, which consists of:
    - determining objectives and their indicators
    - piloting related activities
    - analyzing obtained results
    - permanently undertaking improvements
- allows one to:
  - better view inputs and outputs and their relationship
  - clarify roles and responsibilities
  - judiciously assign necessary resources
  - break down barriers between departments
  - decrease costs, delays and waste
- and ensures in the long run:
  - control
  - monitoring and
  - continual improvement of processes

For a consulting, support or repair business identifying and defining processes and mapping may not be very useful. More important is to establish and describe for example:

- job descriptions
- staff skills
- the tools to use
- preferred methods for certain recurring cases

The process approach **is not**:

- crisis management (“You will not solve the problems by addressing the effects”)
- blaming people (“Poor quality is the result of poor management.” Masaaki Imai)
- prioritizing investments (“Use your brain, not your money.” Taiichi Ohno)

4 Cost categories

The costs of obtaining quality (COQ) fall into two main groups:

- compliance costs (CC) and
- non-compliance costs (NCC)

Compliance costs (CC), also called unavoidable costs or quality costs, are the costs of doing it right the first time, every time. These are investments.

Non-compliance costs (NCC), also called avoidable costs or non-quality costs, are the costs associated with anything that was not done right the first time. These are losses.

As shown in figure 4-1, compliance costs (CC) fall into two categories:

- prevention costs (P) and
- detection costs (D)

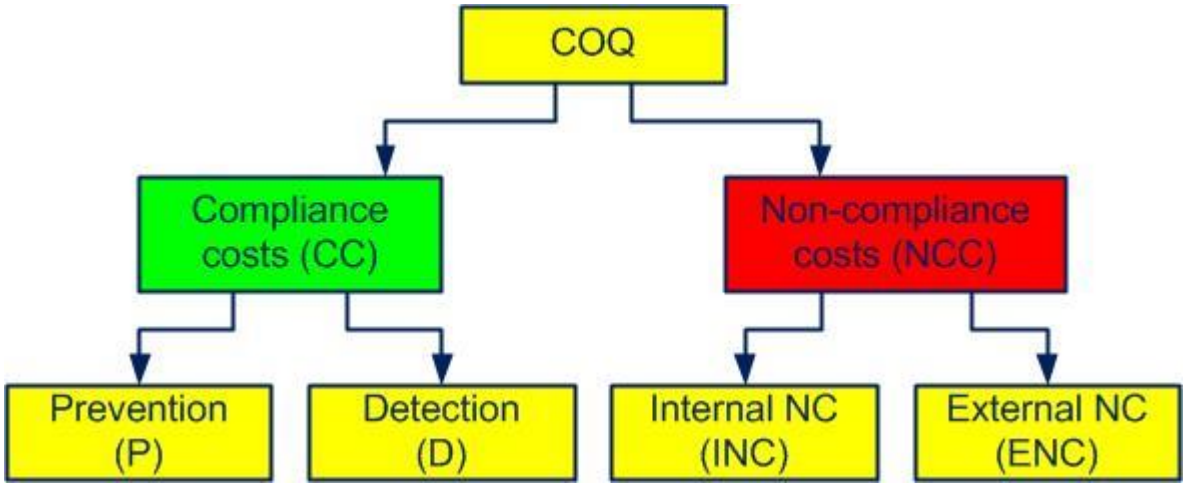


Figure 4-1. Cost categories

Non-compliance costs (NCC) fall into the following categories:

- costs of internal non-conformities (INC) and
- costs of external non-conformities (ENC)

4.1 Prevention

Prevention costs (P) are the expenses incurred to avoid nonconformities (NC). This category mainly includes the following types:

- quality function (salaries, documentation, preventive actions, management reviews, miscellaneous expenses)
- supplier evaluation (selection, supplier audits)
- staff awareness (motivation)
- staff training
- preventive maintenance
- internal system audits
- design of new products, processes
- improvement of processes, products, equipment (Kaizen activities)

- evaluation of personnel upon hiring
- contract review
- environment function (salaries, facilities, miscellaneous costs)
- occupational health and safety function (salaries, equipment, signage)
- FMEA
- PPAP
- value analysis
- SPC

4.2 Detection

Detection costs (D, also called appraisal, inspection, evaluation, measurement) are the expenses incurred to verify the existence of nonconformities (NC). This category mainly includes the following types:

- inspection and test function (salaries, documentation, inspections on receipt, in production, on shipment)
- validations (new projects, processes, equipment, miscellaneous costs)
- verifications (tests including destructive, laboratory costs, inventories, evaluation of products in stock)
- purchase or construction of measuring and monitoring equipment
- monitoring and measurement (samples and specimen)
- depreciation of equipment
- metrology (calibration and checks of measuring and monitoring equipment)
- annual staff interviews
- internal process and product audits
- external audits (certification)
- customer satisfaction surveys

4.3 Internal nonconformities

The costs of internal nonconformities (INC, also called anomalies, failures, defects, malfunctions and scrap) are the expenses incurred because of nonconformities (NC) that the customer does not perceive. This category mainly includes the following types:

- processing of nonconformities (analysis, recording, sorting)
- curative actions (touch-ups, repairs, re-conditioning, re-tests, additional 100% inspection before being put back into the normal flow)
- scrap (including handling, storage, transport, destruction, disposal)
- abnormal consumption of raw materials, energy, information
- finished or in-process products downgraded
- losses due to unusable purchases (supply errors, changes to the finished product)
- losses due to finished products in stock (logistical errors)
- accidental pollution (depollution installations, discharge inspections, fines, compensation)
- workplace accidents (sick leave, replacement staff)
- staff rotation (training new employees)
- absenteeism (unpredictable, replacement staff)
- curative maintenance (equipment and machinery out of order, production stoppages)
- corrective actions (unplanned changes to product, process, tooling, tools, equipment and documentation)
- additional tests
- finance costs (accounting errors, delayed invoicing)

An example of defect codes (solder and PCB) is shown in annex 04.

4.4 External nonconformities

The costs of external nonconformities (ENC) are the expenses incurred because of nonconformities (NC) that the customer receives. This category mainly includes the following types:

- disputes with customers (lawsuits, complaints, compensation)
- exceptional transport (helicopter, plane, taxi, express parcel)
- customer complaints and returns, products under warranty, withdrawals (penalties, return reimbursement, transport, analysis time and action plan)
- supplier complaints
- out-of-warranty after-sales service (part of the costs graciously offered to the customer)
- reductions granted (discounts, rebates)
- late penalties (fees for failure to meet deadlines)
- reimbursement of damage caused to others
- legal fees
- insurance premium
- expert fees
- subcontracting fees imposed (recall, withdrawal, return, destruction, disposal)