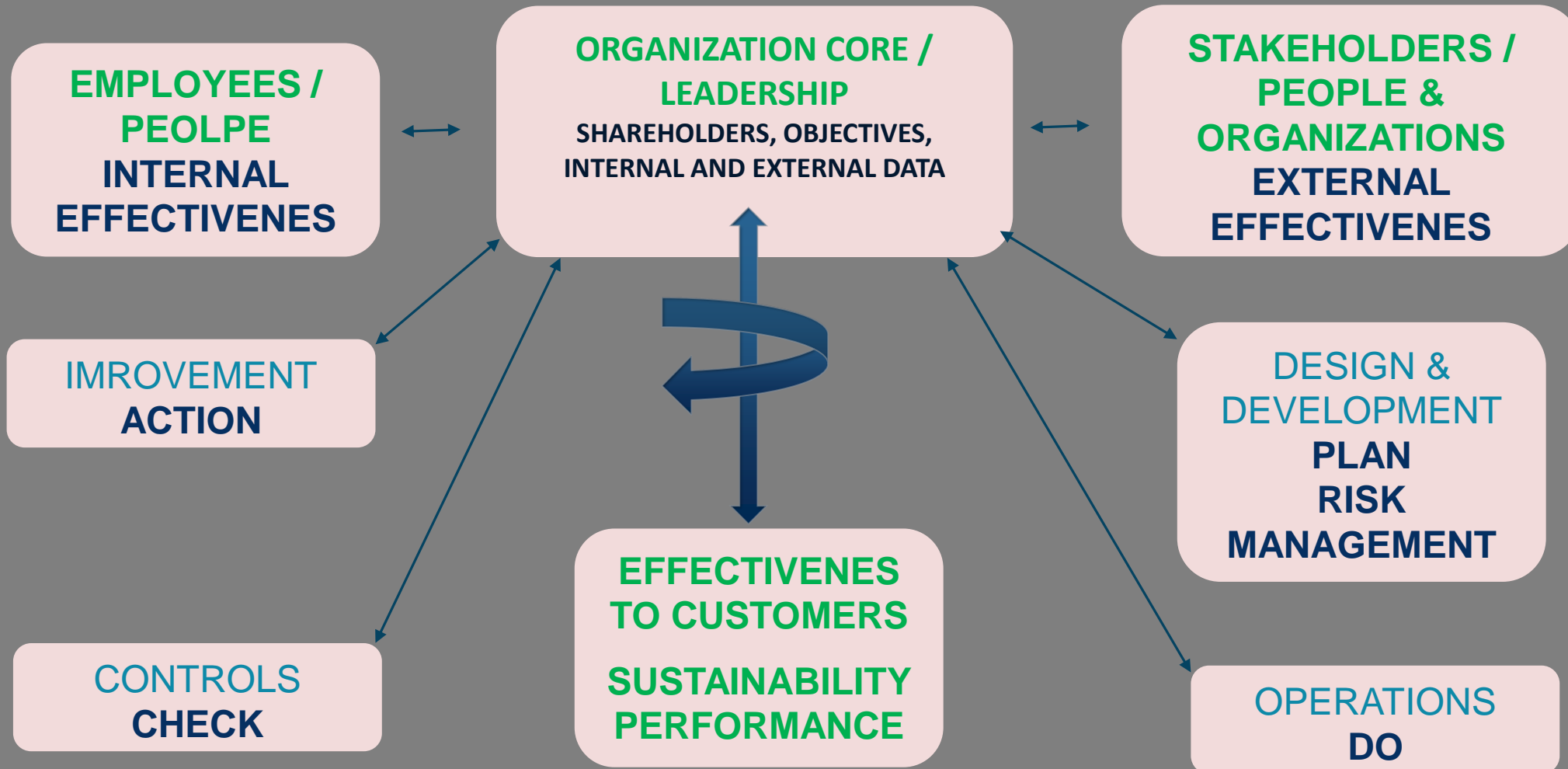


# Quality Management System according to ACI121R-08

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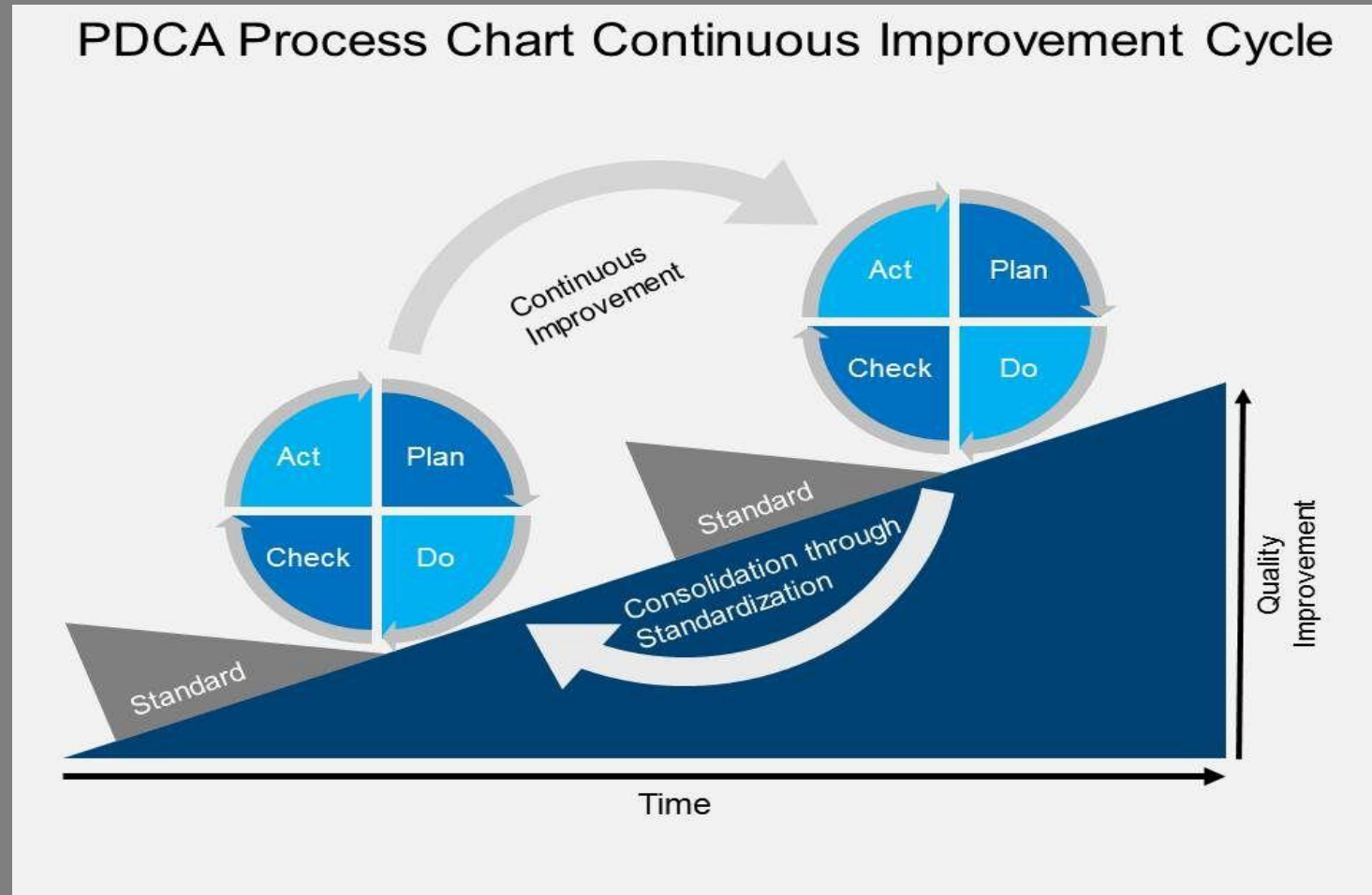
# Introduction

## ► Business Diagram for Quality Performance




# Introduction

## ► PDCA – E.DEMING Cycle



# Introduction

## ► Basic Terms in Quality Management

- Objectives  Depending upon the:
  - ✓ Legal system of a country,
  - ✓ Ownership structure of the organization. Which means, culture (ethics, values, policy),
  - ✓ Brands of the organization
- Processes,
- Procedures,
- Work instructions,
- Risks on objectives,
- Awareness & Engagement people,
- Interaction

# Introduction

## ► Basic Terms in Quality Management

What is a process?

What is a procedure?

What is a work instruction?

What is Risk on objectives?

- **Process** ➡ Flow of inputs and outputs information, that answers questions as follows:

- What we want to do?

- Why?

- Who are involved?

- How ? (mentioning the resources, methods, etc., not an analytical state)

- When it starts? – when it ends?

- How much it costs?

The result (output) is the input for another Process... It can be called :

“Net of the Organization”

- **Procedure** Gives an analytical state, how the process needs to be done
- **Work instruction** Explains how to carry out the procedure
- **Control objectives with risk register**  $R \text{ (Risk)} = P \text{ (Probability)} \times I \text{ (Impact)}$

## ► Commonly used terms

- **Quality control:**  
action taken by an organization to provide control and documentation over what is being done or is being provided so that the applicable standard for good practices and the contract documents for the work are followed
- **Quality assurance:**  
action taken by an organization to provide and document assurance that what is being done or provided are in accordance with the contract documents and standards of good practice for the work
- **Quality manual:**  
The entire body of quality documents that collectively **describes the quality management system**
- **Quality plan:**  
the overview document that **describes the objectives** of a quality management system
- **Work methods:**  
**The processes used** to produce and supply a product or service

## ► **Setting up a quality management system**

- ✓ Identify the processes the organization uses to provide its products or services,
  - ✓ Determine the interaction of those processes,
  - ✓ Manage and continually improve the effectiveness of the system
- 
- Suggestion for the accomplishment of the above is to draw a flow chart of all the processes  
This provides a simply way to understand all of the inputs and interfaces and to evaluate the system

## ► Documenting a quality management system

- ✓ The organization should determine the approach that best suits its needs,
- ✓ Field conditions and sequences of installation not within the bounds of common practices, need to be detailed,
- ✓ The competence of the operating personnel is very important  
When people are highly skilled and experienced the need to document may be less and common processes may require only a minimum amount of documentation

### The existence of documented procedure is mainly required:

- Control of documents and records,
- Internal audit,
- Control of non conforming product and corrective actions,
- Risk management



## ► Documenting a quality management system

**Employees should have the information needed to do their job. Some common terms for this purpose are:**

- Work practices, work procedures, work methods (work instructions),
- Operating practices or instructions,
- Production schedules,
- Preferred suppliers list,
- Specifications &
- Drawings

**Documentation should indicate:**

- Which positions within the organization perform a specific task,
- Where the task is performed,
- When the task is performed,
- How the activity shall be performed depends on the qualifications of individuals performing the task

## ► What is a quality manual?

## ► What should be included in it?

### What it is?

- Is a document to describe the Organization Quality Management System (QMS),
- How much detail is included in it, is up to the Organization to decide,
- Is the entire collection of documents related to quality, as:
  - Quality plan,
  - Quality procedures,
  - Work methods

### What should be included?

- The scope of its application,
- Identification of any excluded requirements,
- The documented procedures (in detail or by reference) &
- a description of the sequences and interaction of the processes

## ► What is a Quality Plan?

- ✓ A Quality Plan is **specific to a particular product or service**, and details how the requirements of the client or contract will be met
- ✓ In QMS, procedures and methods can be added or revised individually without reissuing the plan
- ✓ The quality plan spells out the Objectives of the QMS for the project,
- ✓ The procedures (referenced in the plan), provide the methods by which the Objectives are realized
- ✓ The work methods provide the details of execution

## ► **Work methods and procedures**

- Depending on the complexity of the project work methods and procedures can be combined or separate

**Procedures and work methods should describe the particulars of executions, such as:**

- The application,
- Test methods,
- Acceptance criteria,
- References,
- Documentations requirements,
- Responsibilities

## ► Control of documents

### Which documents need to be controlled?

**“Controlled” means** having a systematic, planned approach to document preparation, identification, availability, storage and revision control

#### Typical internal documents:

- Working drawings,
- Shop drawings,
- Procedures,
- Instructions,
- Reference materials &
- Check prints of designs, drawings and specifications

## ► Control of documents

### Which documents need to be controlled?

Typical external documents:

- Regulations,
- Specifications,
- Contract drawings,
- Change orders,
- Request for information &
- Field change notices
- **Examples of documents that need to be controlled**
- Design outputs (such as drawings and specifications),
- Contract documentation (including variations with clients and suppliers),
- Outputs from planning activities such as design verification, schedules and checklists,
- Documents describing the operation of QMS (Quality manual, procedures, etc.),

## ► Control of documents

### Which documents need to be controlled?

#### Examples of documents that need to be controlled

- Policies and guidelines,
- Organizational structure and position descriptions,
- Design input including standards, codes, design briefs, environmental impact statements &
- Software used for design

#### Note:

*The Paper copy of an electronic document, should be indicated with a statement “uncontrolled” and it is up to the reader to verify that it is the latest copy by checking the network*

## ► Control of records

Records are a statement of the facts existing at the time an activity occurred and they can not be revised

Superseded or revised documents can become records

Typical types of records:

- Design files and calculations,
- Clients' orders and contract review,
- Meeting notes,
- Internal audit reports,
- Details of non conformities,
- Risks register,
- Purchase orders,
- Suppliers' test records,



## ► **Control of records**

Inspection records,

-Calibration reports,

-Training records,

-Details of goods received and delivered,

-Construction photos and check prints

**For concrete construction, the following records should be maintained:**

-A recorded diary of a construction project (this is extremely valuable, especially when a problem develops),

-Daily photographs that are properly dated,

-Identification, examination, acceptance and testing of materials and subassemblies,

-inspection before casting concrete (size and position of reinforcing or prestressing steel, join materials, location of pipe, condition of soil in excavation, etc.)

## ► Control of records

**For concrete construction, the following records should be maintained:**

- Preparation of concrete specimens and their proper storage while awaiting testing,
- Stressing records for post –tensioned construction,
- Performance of tests for temperature, slump, cube or cylinder strength, air content and unit weight,
- Inspection of form removal and finishing of formed and unformed surfaces,
- General observation of equipment, working conditions, weather and other items that could affect the long term durability of the concrete

***How much detailed ?***

*The Organization will determine what records are required*

*Each type of record should have a plan for how long it needs to be kept, where it will be stored and how it will be disposed of*

## ► **Top management commitment**

### **Top management**

The person or group of people who directs and controls the Organization at the highest level

### **Evidence of commitment can be achieved through:**

- Business-planning processes that identify clients and the regulatory requirements applicable to the Organization,
- Identifying the Organizations' policies and objectives,
- Communicating the quality policy and objectives to the people,
- Management review &
- Providing resources,
- Engaging people

### **What does the client want?**

**It is the responsibility of top management** to make certain that clients' requirements are understood and that the necessary resources are available

## ► Quality policy

**A quality policy establishes a commitment to:**

- Quality,
- Continual improvement of the QMS,
- Framework for quality objectives &
- Internal communication and review

Note:

*A quality policy should be a clear statement of the organization's commitment to a Standard of quality*

*This should provide evidence of commitment from the top management that quality will not be compromised when it is in conflict with other interests*

## ► Quality objectives

**The established objectives should be realistic and related to achievable and measurable outcomes such as:**

- Meeting specified technical, safety, environmental, time and financial requirements for a product or service,
- Documenting various internal business processes,
- Improving contract documentation,
- Improving training,
- Controlling operations / projects,
- Identifying and controlling nonconformance,
- Gaining repeat business &
- Identifying new market and service opportunities

### Note:

Objectives should focus on areas that will bring a return to the business in both, financial terms and in terms of increasing clients' satisfaction

## ► Setting quality objectives on projects

Projects objectives should be consistent with the organization's objectives

Project objectives can be more specific to project deliverables and the client's objectives

**For instance, if an organization is responsible for the management of the project, it may need to:**

- Ensure that it has identified its objectives appropriately,
- Ensure that the project objectives are realistic and are able to be communicated to all levels within the project,
- Ensure that it includes a review of its performance, in meeting these objectives as part of the management review,
- Identify the suppliers involved with the project that are required to establish quality objectives consistent with the project quality policy

## ► **Quality management system planning**

Control is the act to compare planned results to achieved results

If there is no plan there is no control

### **Planning at two levels:**

- Planning necessary to meet the requirements of a standard,
- Planning necessary to meet the quality objectives

### **Construction project planning**

A construction project is a one time multitask job with:

- a starting point,
- a defined scope of work,
- a budget &
- a team of professionals often brought together for the first time, with different formats, methods and business culture

## ► **Quality management system planning**

The clearly defined scope is a major issue in construction projects

It is the client's (owner's) responsibility to communicate with the construction organization to ensure the scope is clearly defined

**The recommended model managing a project:**

### **A. Definition**

- Define **the issue**,
- Develop **the vision**,
- Write **the mission statement**

### **B. Planning**

- Develop **strategy** ,
- Develop **implementation planning**,
- Develop **risk management**



## ► **Quality management system planning**

The recommended model managing a project:

### C. Execution

- Do **the work**,
- **Monitor** the progress,
- Take **corrective action**

## ► Responsibility and Authority

### ► Who does what?

- **Top management** needs to ensure that people in the Organization know what is **expected** (responsibility) and what is **allowed** (authority)
- An organization chart should be included in the Organization's QMS, to define lines of responsibility
- Although individuals should be aware of his/her quality responsibilities, **there should be a system of quality control, including inspections or checking to ensure accountability**
- One task of management is to **develop a written plan for quality control (QMS)** that include all activities critical to quality, criteria and frequency of inspections or checking and the assignment of responsibilities
- Qualified personnel can then develop a checklist for inspection
- **Every contractor should be responsible for quality and should communicate** to all employees that:  
  
“We do quality construction and we are proud of each of our projects”

## ► **Keeping people informed**

For a QMS to work effectively, good communication is essential

**For an effective communication, the employees should have the ability to:**

- Transmit and receive information quickly and to act on it,
- Built trust with each other,
- Transmit the importance of client satisfaction and process performance,
- Identify opportunities for improvement

**Communicating information through a variety of means as:**

- Bulletins,
- Newsletters,
- Internal meetings,
- Meeting minutes,
- non conformance logs,
- Circulation of reports

## ► Is the quality management system working?

-**Top management** should **review the QMS** on a regular basis

-**A new system should be reviewed quarterly, with reviews given annually thereafter**

The reviews should be preplanned

-**The form in which the management review will be recorded, should include identification of:**

- Date and location of the review,
- Scope of review (full system or part of it),
- Identify of participants (name & functions),
- Minutes of proceedings &
- Actions (if any) and responsibilities, including target dates

## ► Is the quality management system working?

**Actions resulting from the review meeting are those that require top management understanding or endorsement such as:**

- Trends,
- Amendments to policies,
- Improvements,
- issues involving capital expenditure,
- Risk management actions,
- Follow-up actions

*The record of management review becomes the first input into the next management review*

## ► Resource management

## ► What is needed?

**Organizations need to make sure the resources needed to:**

- Implement,
- Maintain,
- Improve

the QMS, are available

**Within the construction industry resource management occurs in response to a change to workload such as:**

- Winning a new contract,
- Scope changes to an existing contract,
- Dealing with unpredictable conditions

### Note:

Resources include not only the personnel required but also finance, facilities, equipment

(i.e. develop new procedures / methods, obtain additional equipment – rented, leased, purchased, acquire the resources and skills through a subcontractor)

- ▶ **Are the people ready to do what required?**
- ▶ **Checking awareness, competences and training**

The most important factor in achieving a desired outcome and clients' satisfaction is having competent people doing the right job (Personnel performing work, affects product quality)

Organization should **compare** the:

- experience,**
- qualifications,**
- capabilities &**
- abilities**

of the people, relative to the **skills & qualifications needed by the business, for current & future contracts**

Notes:

- In the concrete construction processes, **the ACI certifications programs** can be a key element **for concrete testing technicians and craftsmen**
- **Training programs** may be developed to **fill needs or to further develop the organization's capabilities**
- **Training** on the QMS or on work methods **can provided by a review meeting**

- ▶ **Are the people ready to do what required?**
- ▶ **Checking awareness, competences and training**

**How is employee awareness raised?**

- ✓ Orientating employees to the organization's quality policy when safety orientation is conducted,
- ✓ Holding team briefings (for instance, design and construction start-up),
- ✓ Holding toolbox meetings on the work sites, when safety toolbox meetings are conducted (to generate quality awareness at the craft level, it is practical to generate job specific handouts that express topics in short bullets with illustrations and photos),
- ✓ Ensuring that quality objectives are highly visible to employees (for instance on meeting agendas and displays),
- ✓ Recognizing and rewarding good work performance,
- ✓ Reporting nonconformances and actively giving employees information about why nonconformances occurred and how they were resolved



## ► Planning process management

All the activities related to a service delivery or to the manufacturing of a product, need to be planned

Some interesting points for designers:

- Consider what the **client wants?**
- Provide a procedure for **checking drawing and specifications before issue,**
- **Review** design **outputs against inputs** specifications

Some interesting points for construction activities:

- Determine the **resources** needed,
- Determine **the criteria for acceptance** of all items in each work method,
- Determine the **records required** (final inspection reports)

## ► **Planning process management for the construction industry**

The ability to bring together a project team to deliver what the client wants, requires careful selection of the parties involved

The output of the planning for a specific project can be a:

- project plan,
- project schedule,
- work method or
- a combination thereof

If the organization decides that a formal project plan is needed it can be as:

- brief,
- checklist or
- flowchart

with references to the documents or parts of the QMS

## ► **Planning process management for the construction industry**

Plans could include:

- **Responsibilities** (the person or organization responsible for verification),
- **Stages in the process** when verification is to be carried out (hold points),
- **Methods**, equipment and cycle time,
- **Frequency** of inspection and criteria for acceptance,
- **Records** of verification to be made and their format,
- **Review, distribution and retention**

Where applicable, the organization needs also **a plan to address handling of materials and items accepted** on the basis that evidence of compliance would be available (for instance: concrete delivery acceptance for which the strength at 28 days or/and the water-cement ration are specific requirements)

- ▶ **Review of requirements related to the products**
- ▶ **Determination of requirements related to the products**

The purpose of a construction QMS is to ensure that the project is being constructed in compliance with plans and **specifications**. **Specifications** are a legal contract and should be treated as such

The purpose of a specification is to ensure that the:

- quality of the workmanship,
- tolerance control,
- materials needed,

**satisfies the client's requirements**

Note:

*Sometimes a specification may conflict with local practice or the experience of the contractor. If the contractor finds that a specified item of the project can't be achieved a meeting should be arranged with the designer to fully discuss the issue. All such issues and the decisions reached should be recorded and kept with the contract documents*

## ► Review of requirements related to the products

## ► Understanding the client's requirements

A **process** of review of the contract required to ensure that all the requirements can be met. Contractors should determine if there are any design requirements

Sometimes it is possible to meet the minimum contract requirements and still not satisfy the client

Bid requests and proposals should be reviewed to ensure that the requirements:

-are understood,

-can be met &

-The project management system can deliver

Note:

A record of the review is required and it can be as simple as a notation on the contract paper

## ► Client communication

- In order to ensure that the **client's expectations** are met, **identify and document** the client's **requirements**
- Achieving **client's satisfaction** usually includes **not only Technical requirements**
- All the requirements should be discussed before signing the contract
- Any change** to a contract paper should be reviewed in **the same manner as the initial contract paper**
- Everyone affected by the change should be informed
- A process** required **for managing changes** in the **work scope**
- No work should proceed until the client has approved scope changes

## ► **Design and Development planning**

- In the construction industry design can apply not only to the permanent constructions but also to temporary constructions that enable the constructions of the permanent structure (for instance the specific methodology could be applied to designing forms for concrete or a concrete mixture). Activities for the design methodology relating to the management and its performance continue into the construction phase and to completion of the project
- Design firms need to plan the design activities and to the individuals who will perform them
- Responsibilities for design should be clearly assigned
- Methods for implementing and updating the design plans, should be established
- If there is more than one designer or if the design is packaged into separate stages then it is possible to allocate the design stages to different designers and it should be shown in the design plan
- A small business may only have one designer
- If design is outsourced, a QMS should be implemented by the source

## ► Design and Development inputs

Factors that need to be considered and recorded:

- The **client's needs** are a **major** consideration even though may not always be clearly stated,
- Use of the facility, the environment in which it functions and the expected lifetime,
- Aesthetics,
- Available technology and materials,
- Constructability issues that concern common practices, logistics, limitations of materials and accepted standards



## ► **Design and Development outputs (results)**

- The developer of a design package is required to document its design output in a way that it can be verified against the requirements contained in the design input
- **In the construction industry the design output is usually design drawing and specifications.** Specifications should be clear in stating what is required
- Design output **becomes input for purchasing, construction or other activities**, therefore it **needs to contain clear and sufficient criteria** for the acceptance of the work,
- may also need to **include requirements relevant to the procurement, construction, maintenance and operating processes**
- **Requirements may relate to protecting existing conditions or to ensuring the suitability of the completed work or processes**

## ► **Design and Development outputs (results)**

For instance:

1. The accuracy and calibration requirements for instruments,
  2. The construction processes that require validation,
  3. The specific construction records and requirements for spare parts
- etc.

- **Design output documents treated as controlled documents and should be approved and signed before issue by:**
  - the Engineer of record, Lead Design Professional in Charge & the owner's representative or
  - the owner him/herself alone, if the owner has assumed the role of Engineer of Record

## ► Design and Development review

### Design review:

- Is the formal checking of design planning inputs and outputs,
- Can take place at any stage of the design process,
- May take a variety of forms, including meetings, and circulation of design documentation,
- Simple designs may only require one review,
- Complex designs, will require more frequent review

## ► Design and Development verification

### Verification

Is checking that the results of the design process meet the requirement identified at the start of the design process

### **What is the difference between design review & design verification?**

**Verification** : requirements confirmation for each design element and design package individually (from input to output)

**Review**: Involves project participants at specified stages in order for each other to ensure, that the design elements and packages meet the requirements of the project functions and are capable of achieving their objectives

### **Methods of design verification include:**

- Performing alternative calculations ,
- Comparing the new design with a similar proven design,
- Undertaken tests,
- Checking the design documents before release

## ► Design and Development validation

### Validation:

-Is the process of checking that the final product or service will be capable of meeting the client's requirements

For construction projects validation can mean checking that the completed component will meet the requirements for the project. Involves trial runs to determine if the equipment functions as specified

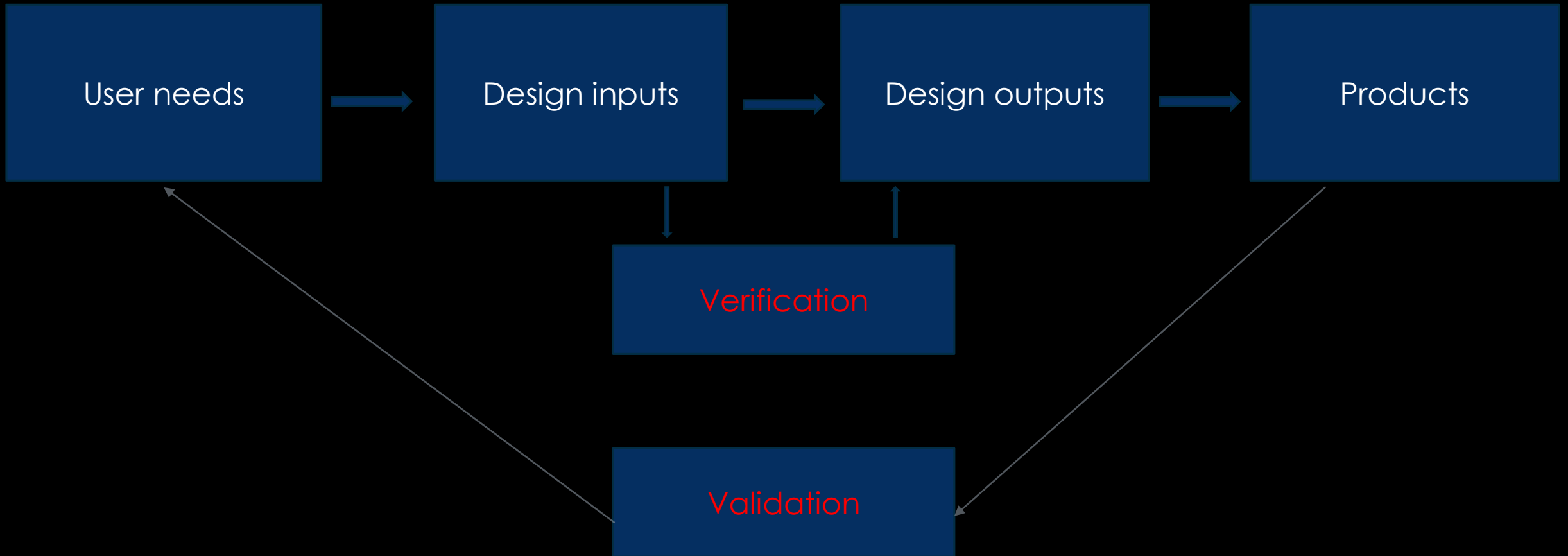
**-All the requirements that are subject to design validation, the criteria for assessment and the role of the organization** need to be clarified, documented and agreed with the client

-May be performed by the client and to provide feedback to the designer

### **Examples of design validation include:**

- Commissioning of process plants , such as wastewater and water treatment plants,
- Pressure testing of piping systems or pressure vessels

## ► Design review figure



## ► Control of design and development changes

- A study performed by the Construction Industry Institute, indicated that over 50% of rework costs, are due to design changes,
- The QMS requires formal documents and change control procedures that must be followed
- A design changes protocol is required (revisions initiation and communication)
- Once construction has started, changes should be completed in a timely manner ( first changes then items building)
- Super-intendants are required to sign off daily to make sure that any changes that affect their area are realized
- Site changes involving design matters will need to be referred to the appropriate designer
- In order to address the design and development changes:
  - Request for information ( RFIs) are useful tools,
  - Field change notices (FCNs) ,
  - Non conformance reports
- Necessary resources should be available, by the organization

## ► Purchasing process

### Management of purchasing:

- Selecting suppliers
- Specifying requirements,
- Evaluating if specifications have been met

### Before the final selection of a supplier it is wise to:

- Conduct an audit of batching facilities,
- Review strength histories,
- Evaluate the supplier's response to previous issues (if there are any),
- Review documentation control

### Note:

The selection criteria for the selection of suppliers, should be outlined by the organization

Records should be maintained of the approved suppliers



## ► **Stating purchasing requirements**

**-In the construction industry purchase orders should be written (phone orders should be confirmed by fax or email) and need usually to define:**

- Scope,
- Timing,
- Constrains,
- Performance requirements, technical requirements and acceptance criteria for the work,
- QMS requirements for suppliers and subcontractors
- Documentation to be provided and applicable controls to provide confidence about compliance to specify requirements

**-Organization should reserve the right to carry out planed surveillances and audits**

**-Purchasing documents should be maintained at least until the contract closeout**

## ► **Verification of purchased product**

**The quality control measures for a project need to be established to the purchasing instructions**

**For verification:**

- **Determine with a simple checklist** that what was delivered matches the purchase order,
- **Conduct** a surveillance audit at the supplier's plant, to inspect what is ordered

**In the construction:**

- it is typical to assign an inspector to the batch plan, on major concrete placements,
- Shop inspection of reinforcing steel suppliers is often conducted to verify bending and coating practices and to confirm traceability of materials

**The detailed requirements of an organization's inspection plans will be derived from :**

- Codes,
- Standards,
- Specifications

## ► Verification of purchased product

### Developing inspection checklists

The checklists should be signed off by all parties including:

- Production supervisors,
- Subcontractors,
- Inspection stuff,
- Owner's representative as applicable

### Checklists sources :

- *ACI Manual of Concrete Inspection (SP-2)*
- *International Conference of Building Officials , Construction Inspection Manual*
- *National Ready Mix Concrete Association Batch Plant Certification Checklist*

## ► **Control of production and service provision**

Controlling what you do:

- Various types of controls for supply, production, service,
- Applicable statutory and legal requirements need to be addressed whether or not these are stated in the contract,
- Processes should be documented,
- Work methods, referred to specifications, often documented to control work. They include:
  - work instructions,
  - equipment requirements,
  - Inspection and testing requirements,
  - post-delivery requirements,
  - Inspection records and often
  - a log or index of inspection records
- it should be insured that the personnel involved are familiar with any site or customer specific requirements

## ► Control of production and service provision

### Controlling what you do:

- After the delivery of the product, any service or maintenance should be provide in a control manner

(For instance: the maintenance of a highway facility – snow removal – after the highway is opened for traffic but before the customer formally accepts the facility )

### Suggested training and certifications programs for concrete construction

1. The **National Ready Mix Concrete Association** has a certification program that provides details for the production of concrete mixtures. **The three-part quality control manual** is a comprehensive guide for a concrete producer's production control
2. The **Prestressed Concrete Institute** has a certification program for prestressed concrete producers
3. The **Post Tensioning Institute (PTI)** sponsors training and certification programs for installers, inspectors and manufactures of post tensioning systems

## ► Validation of processes for production and service provision

### Processes which need validation:

1. The results of measurements to confirm that the product meets requirements are not immediately available,
2. The measurements can not be carried out without destroying the product, therefore the processes are conducted with certain controls as a condition of their acceptance,
3. Both existing, (1) & (2)

### Examples

1. An example for the 1<sup>st</sup> situation, at the time of placing concrete, the properties of the hardened concrete are not known.  
Control of the mixing and delivery system is essential
2. Welding is an example of the second situation, welding procedures are an example of a validated process. The welder is required to be trained and qualified

### Notes:

*-The specification needs to identify the processes that need validation and determine the validation evidence that need to be provided by the organization*

*-For processes outside of those required in the project specification, their necessity for validation need to be identified by the Constructors*

## ► Identification and traceability

Keeping track of what you are doing

Identification: is knowing the product or service that results from a particular process

- The identification method for each product or service should be documented,
- Identifications records should be kept

Traceability: is knowledge or record of:

- Where the product or service came from,
- Where it is currently,
- In the case of service, its current status

(For instance: job cards entries, recording of the location of particular materials – batches of concrete)

Note:

Records that provide traceability should be maintained

## ► Identification and traceability

In concrete construction traceability:

- is often an underemphasized issue,
- of structure to the truck load, is usually recorded adequately

Notes:

- Sources of aggregates and cement require solid control to prevent variances by suppliers due to price or availability,
- Reinforcing bar sources are often not closely monitored



## ► Customer property

- Appropriate care need to be taken of **client's property that is being used by the organization or it is under its control,**
- On receiving **property**, its condition should be **checked and it should be determined that it is suitable for the intended purpose,**
- The client's presence on the receiving time, it is advantageous for the client and the organization, as well,
- The **organization is responsible** for ensuring that **the control in place to protect customer property are sufficiently documented,**
- In this documentation** should be **described** exactly how the **property is identified and protected,**
- Records should be kept for all inspections and maintenance
- Information should be given for the property by the client to the organization for the following:
  - Special storage or/and handling,
  - Segregation,
  - Security,
  - Stock rotation,
  - Hazardous materials,
  - Maintenance requirements

## ► Preservation of product

Looking after the product, service or both

-The preservation **requirements** may apply **to a project plan**

-Procedures may not be necessary, when the **work practices address the requirements in details**

-**Regarding the suppliers and their products\*** the organization should be aware of any regulation or requirement concerning :

- Handling,
- Labeling,
- Packaging,
- Storage,
- Delivery to and from storage at the organization site,
- Lifting requirements,
- Expiration dates

\* For instance: Electrical and mechanical equipment, paints, chemicals, hazardous materials, etc.

## ► **Monitoring and Measurement**

What is the difference between Monitoring and Measurement?

Monitoring: Implies the Observation and Supervision activities

Measurement: details with the determination of quantity, magnitude, dimensions (for instance: concrete cube strength).

Testing laboratories

Auditing testing laboratories is advisable, before any work is performed

Calibration documents should be requested, of all equipment to be used on the project

For each reference standard to be valid, it needs to be traceable to an appropriate recognized source. This will normally be a national or international standard

Note

PCI MNL 116, contains requirements for calibration of equipment and records required

## ► **Monitoring and Measurement**

### ► **Client satisfaction**

-Each client perception of a QMS' s performance, needs to be monitored and measured

-It is important to understand how the **client's perception** of the **product quality** relates to their **degree of satisfaction**

In order to understand this, direct client contact is probably the most effective

**The organization may consider who are their clients**

For instance:

1. a **design organization** could view **the clients** of its design output which are **the contractor and the owner,**
2. In the case of a **manufacturer supplying materials or equipment to the construction industry, the clients** could include the:
  - **Architects/engineers,**
  - **Contractors,**
  - **End users**

-In the construction industry, clients are often involved in the review of designs and in some cases in the inspection of construction

## ► Monitoring and Measurement

### ► Monitoring and Measurement of processes

-The most effective way to ensure output quality, is to monitor and control the processes that provide the product or service

-Inadequate control of the process:

- render product verification inappropriate,
- affect the delivery times,
- cause issues in other requirements

-Some of the requirements for recording and reporting the performance of the processes are:

- a quality plan,
- an inspection and test plan,
- a sampling plan

In some cases monitoring and measurement of a process **may be a standard way** of working in the construction industry (for instance: temperature control of concrete mixtures)

- ▶ **Monitoring and Measurement**
- ▶ **Monitoring and Measurement of processes**

-Measurement and monitoring of processes may require limited documentation to demonstrate compliance

(For instance: for a small contractor owner / manager a diary record of site visits confirming the performance of the foreman)

-It is up to the organization, for each process to determine the:

- requirements,
- criteria for acceptance,
- frequency for inspection, &
- documentation requirements

Note:

*The above are typically addressed in the work method (or engineering procedure) for each activity*

## ► Internal audit

### What is an audit?

An audit involves an independent examination of how work processes are being performed (or have been performed)

Compliance with this standard requires qualified auditors who perform audits on a planned basis

### **The audit process should include:**

- planning the audit,
- reviewing the relevant QMS documentation,
- reviewing production reports, failure trends and clients' complaints,
- conducting the audit,
- reporting the results &
- verifying corrective actions

-The frequency of audits should be based on the maturity of the organization and it should be as a minimum cover of all QMS requirements, annually

-The information obtained from internal audit, should be provided as an input into the management review

## ► Monitoring and measurement of product

*Checking to make sure things are right:*

- The organization needs to verify that clients' requirements have been met
- For the verification the organization needs to prepare a predetermined plan. In this plan should be identified the following:
  - methods,
  - sampling plans,
  - criteria for acceptance,
  - task responsibilities,
  - records to be kept
- The consistency of the people involved competences, should be checked through the plan
- The organization needs to organize plans for materials accepted

*For instance: Developing a protocol for of concrete on the basis of plan inspection and field tests upon delivery, can be determined before the 28-days strengths*



- ▶ **Monitoring and measurement of product**
- ▶ **Control of non conforming product**

*What constitutes a non conforming product?*

- Basically a non conforming product is a product or a service that doesn't conform to the established requirements
- In order to prevent unintended uses of a product, it is necessary to be clearly identified and controlled
- When a non conforming product is identified, it should be handled with the following ways:
  - rework the product in order to make it conform to specifications,
  - rework it to make conform to specifications, with the client's approval,
  - repair it, with the client's approval,
  - use it as it is with the client's or designer's approval,
  - Relegate it to another application,
  - scrap it

**In all the above mentioned choices except the scrap choice, the product should be checked to assure compliance**

## ► Analysis of data

*Analyzing data is essential for any possible improvement*

### Collected data

The information that should be examined and evaluated

For instance: Information that should be evaluated is:

- non conformances reports,
- clients' complaints,
- missed schedule dates,
- performance of suppliers,
- downtime,
- clients changes,
- engineering changes or errors,
- supplier changes or error,
- Statistical analysis of measurable products quality

## ► **Continual improvement**

Continual improvement is a recurring, step by step, activity

- Processes for achieving improvement should be planned and produced by the organization
- The collected data should be taking into account in managing the implementation of these processes
- Data performance should be obtained, through these processes

## ► **Corrective actions**

**Corrective action is not** actually a correction or **rework of a non conformance**

**Corrective action is the action** which applied to the procedure to **prevent reoccurrence of a problem**

Specifically, in the **cases** which **something goes wrong** and it has not rectified at the stage of a non conformance **or** in **cases** which there are **clients' complaints**, **corrective actions should be applied**

It is necessary to highlight the following:

corrective action may not be a rework of a non conformance, however, a nonconformance may occur a corrective action to a procedure

The need of corrective actions is identified by factors such as:

- clients' complaints,
- warranty claims,

## ► Corrective actions

- problems with suppliers,
- non conformances,
- rework,
- audit reports,
- statistical indicators of poor production

-All the above are part of a **continuous improvement strategy**. This strategy should be **described in a procedure**

-Corrective actions should be recorded and time limits should be set for their verification

## ► Preventive actions

**Preventive action** it actually **anticipates circumstances** that they may cause non conformances

**Preventive action procedures** should be documented and should be open to all employees, so that they can make preventive action suggestions

A few preventive actions , for instance:

- **Training,**
- **Constructability review,**
- **Establishing a design plan,** the key risks to poor design outputs can be identified and they must be reviewed at each stage of design development so that any issues will be eliminated, promptly,
- **Planning a construction processes,** any aspects that presents a significant risk to achieving the intended outcomes, should be identified and should be reviewed in regular intervals so that any issues will be eliminated promptly

Note:

*Tool box meetings, where safety issues are reviewed are excellent forums to review quality procedures and work methods for risks of poor quality output*

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Thank you

