



# QUALITY MANAGEMENT SYSTEM FOR CONSTRUCTION SITE PERSONNEL

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# OVERVIEW

- The construction industry is being viewed as one with poor quality emphasis compared to other sectors such as manufacturing and service sectors
- Many criticisms have been directed to the construction industry for generally shoddy workmanship. Not just the final product that is subject to criticisms but the processes, the peoples, the materials etc are under tremendous pressure for better quality in construction.



# OVERVIEW



## Constraint of construction industry in implementing Quality Management System

- The product (project) is manufactured at client's premises;
- Each project is one-off design; improvement process may be useless.
- Production processes are to some extent different from one another. Hence, it is almost impossible to establish universal quality standards can be applied to the product nor workmanship.



# OVERVIEW



This talk will focus on general concept of implementation of quality management system in a construction projects starting from :-

- Project awarded to contractor; until
- Project handing over.

This phase is selected because it is the phase in which a large number of occupations, professions, and organisations are involved in the various phases of a construction project. This is also the phase where time, cost, and quality constraints will be questioned the most.





# Reference use for this talk

- **ISO 9001 : 2015** – QMS - Requirements
- **ISO 9000 : 2015** – QMS – Fundamentals and Vocabulary
- **CIS 29 : 2021** – Contractor’s Quality Management System
- **Quality Costing** by Dale, B.L. & Plunkett, J.J. (1999)
- **Basic of Construction Contracts** – Prof. Madya Dr. Nor Ainah Abdullah.
- **PMBOK 7<sup>th</sup> Edition** – Project Management Book of Knowledge.
- Journal **Attitudes of People in The Construction Industry Sector on Issues Related to Delay in the Approval of Submittals** published in *Journal of Construction in Developing Countries* by Penerbit USM, Penang in 2011.
- Journal **TQM in Construction Process** published 1997 in *International Journal of Project Management* by Prof. David Arditti and H. Murat Gunaydin
- Article - Brown, James C. & Cavaluzzi, Gerard P. **Shop Drawings and Other Construction Submittals: Legal and Engineering Perspectives.** Lorman Education Services.
- **Identifying root-cause of long Review Times for Engineering Shop Drawings** – Dr. Chang Sun Ching



# History of Quality



# History Timeline

1450BC



## Pyramid

In pyramid construction, there are evidence that the structure was constructed with precise inspection and measurement.

1046BC-256BC



## The Zhou Dynasty

Specific governmental department was established for inspection and supervision at various stages by workers and seller. Where utensils and silk that are found not in good quality will not be accepted to sold at the market.

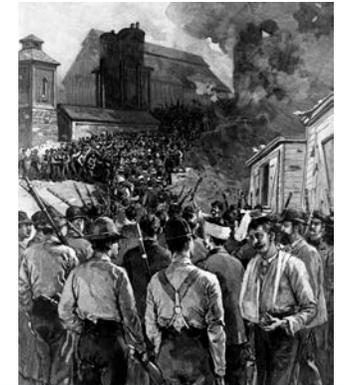
5<sup>th</sup> to 15<sup>th</sup> Century



## The Middle Ages

Craft guilds were appointed by Kings to witness the construction of Church and Palace.

1760-1840



## IRI.0

A French gunsmith (Honore Blanc) developed a system for manufacturing muskets



# History Timeline

1920's



## Inspection Departments

Bell telephone established the Statistical Process Control lead by Walter A. Shewharts.

1940 - 1950



## WW2

A lot of scholars in western world adopt quality management in manufacturing practices.

1950 and above



## Post WW2

Competition between Japan and western to produce quality product.

1980's



## The US Quality Revolution

A lot of theory, producing of system and management concept etc.



# EVOLUTION OF QUALITY MANAGEMENT



A book wrote by **Dale, Lascellas & Plunket (1999)** identified 4 stages of evolution in Quality Management prior and after 2<sup>nd</sup> World War :-

- Inspection – QM will be only during quality control at final inspection before handing over (prior 1940)
- Quality Control – QM were done during quality control at stages (1940 – 1960)
- Quality Assurance – QM not just QC, but also QA (1960 – 1980)
- Total Quality Management – After 1980.



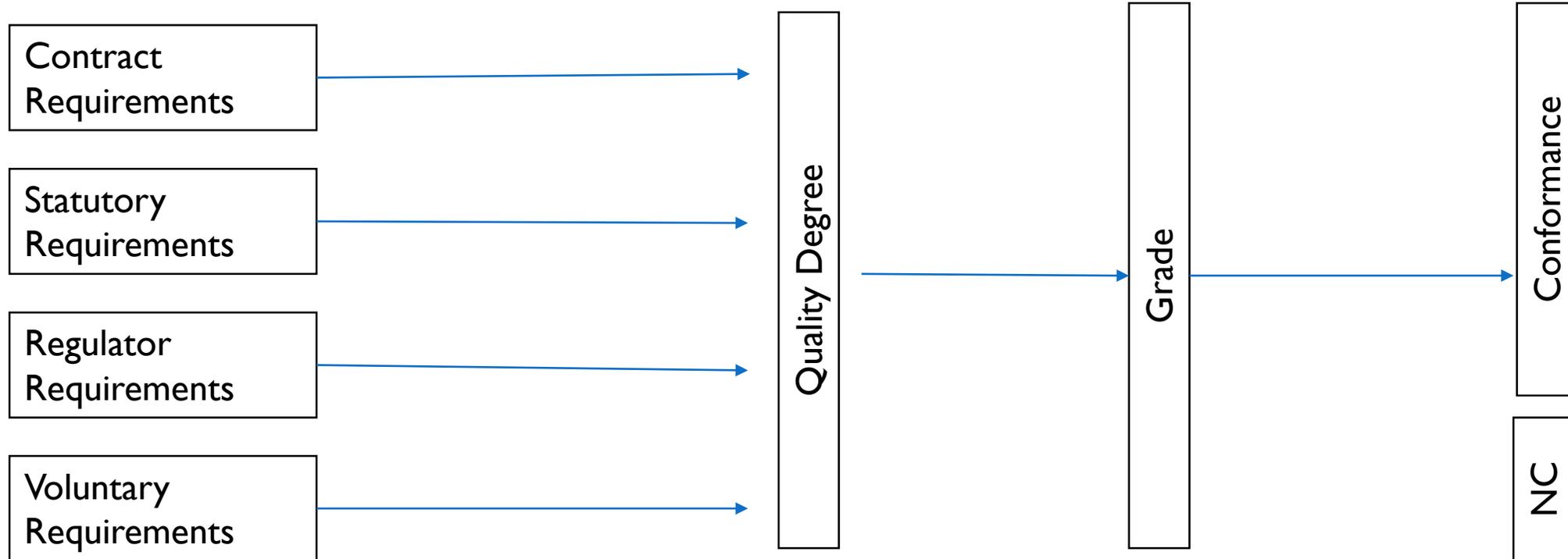
# Quality Definition

Degree to which a set of inherent characteristics fulfils requirement – ISO 9000

Quality is meeting the legal, aesthetic and functional requirements of a projects. – Journal by David Arditi and H Murat Gunaydin



# Quality Requirements



# QUALITY DEGREE



Characteristics of quality that being able to describe, evaluate and analyse

Objective

Subjective

Characteristics of quality that depends on visual inspection, e.g., nice/not, good/bad



# Quality Management

- QM is defined as coordinated **activities** to direct and control an organisation with regard of quality. (ISO 9000:2015).
- Quality Management is about establishing daily/routines activities related to controlling or managing quality performances of contractor/suppliers or etc.

# Quality Management Activities Stages

Project Management Book of Knowledge (PMBOK) 7<sup>th</sup> Edition had stated that main stages of QM is :-

1. Plan for quality (previously known as Quality Planning)
2. Managing Quality (previously known as Quality Assurance)
3. Quality Control

Therefore, what are the activities that we need to plan, manage and control will be discussed in the 4 pillars of construction project quality management.





# Definition of Quality Management System



# Quality Management System Definition

Set of **interrelated activities** or elements of an organisation to **establish policies, objectives and process** to achieve those objectives— ISO 9000

All activities of the overall management function that determine the **Policy, Objectives** and responsibilities, and implement them by means such as **Quality Planning, Assurance, Control and Improvement** within the Quality System – Mane & Patil (Journal 2015)

# 7 Quality Management System Principles

Customer Focus – How to comply with customer requirements.

Leadership – Top management commitment for QMS implementation.

Engagement of People – How to ensure involvement of all staff.

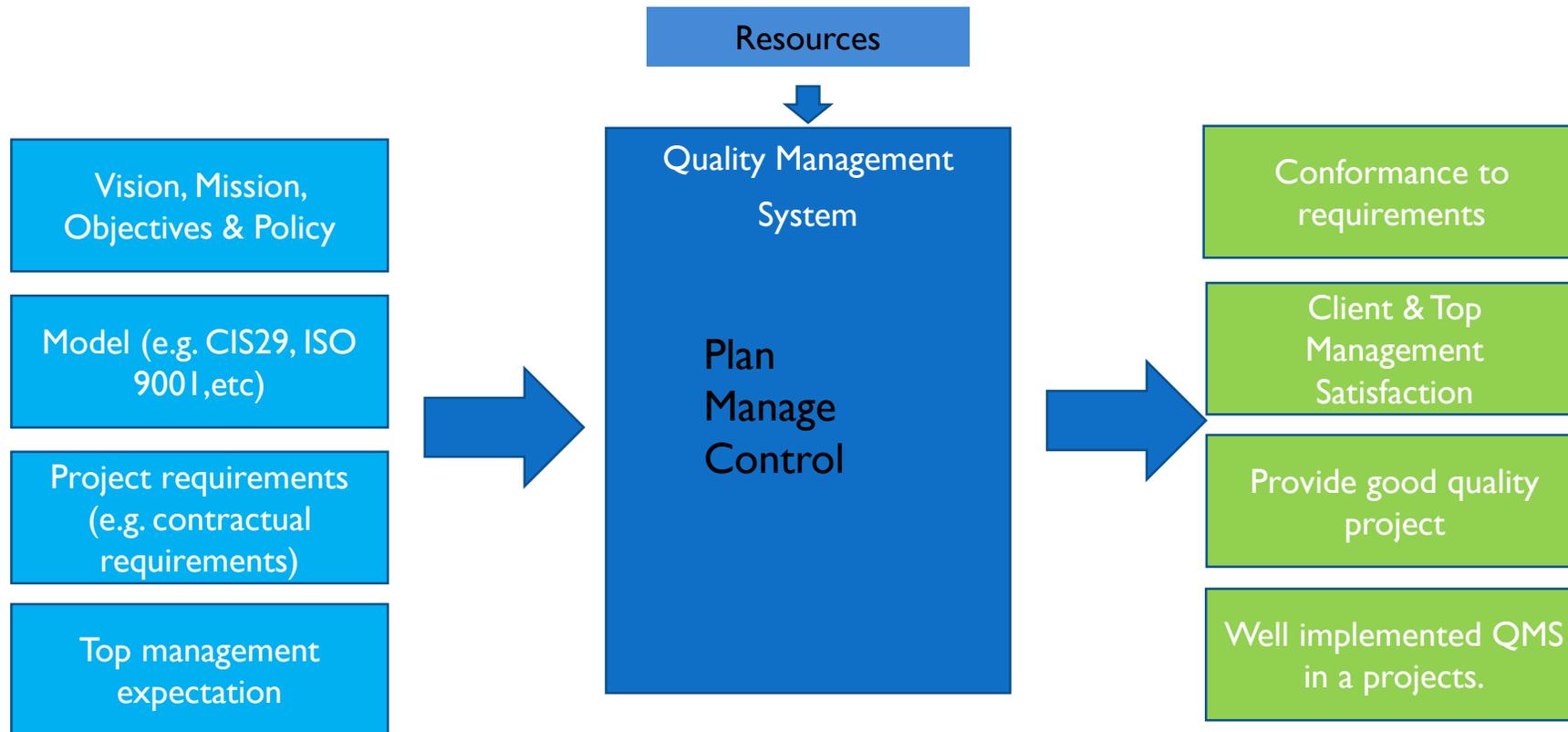
Process Approach – How to ensure every work activity are using process approach.

Improvement – Improvement for QMS if found defect.

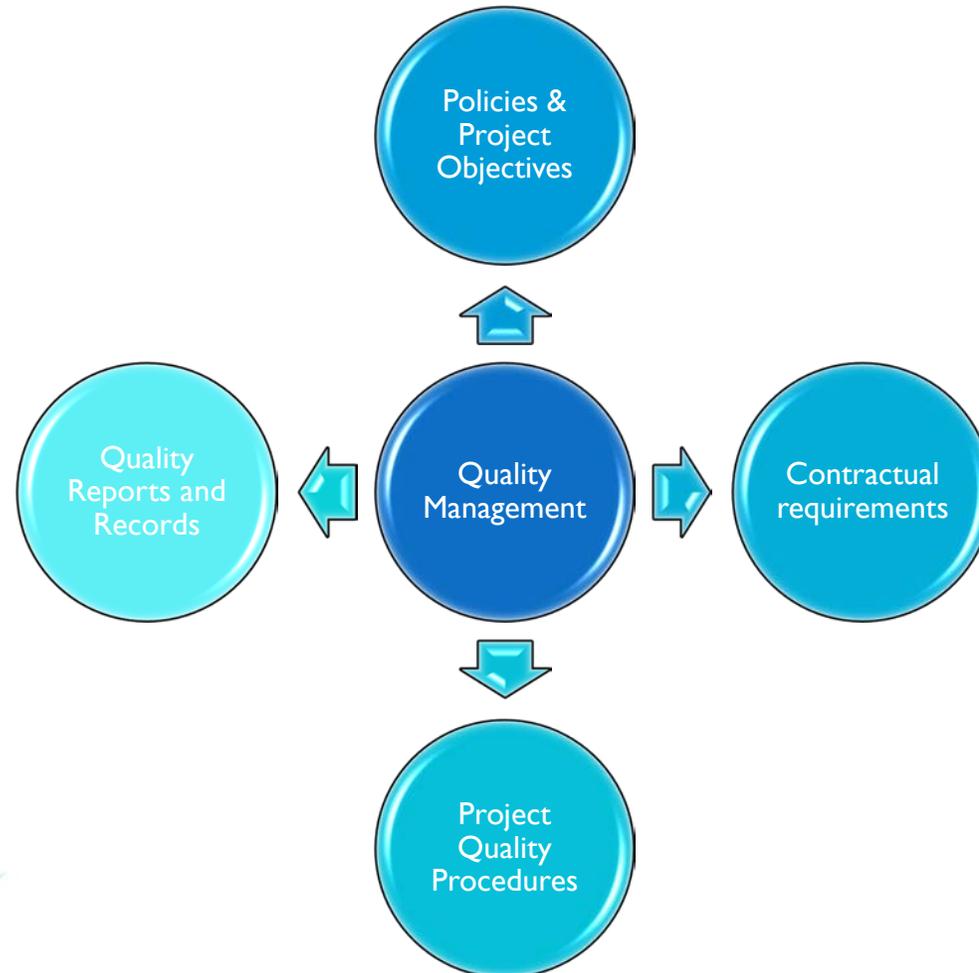
Evidence based decision making – Making decision based on evidence provided.

Relationship management – How to establish good communication plan between client and vendor.

# What is QMS in a nutshell



# 4 Pillars of Construction Quality Management



**Policies & Project Objectives** – How do we disseminate policies of the company and set-up project quality objectives.

**Contractual Documentation** – How do we understand contract documents and interpret in establishment of quality system.

**Project Quality Procedures**– How do we identify project procedures and standardise all procedures

**Quality Reports & Records** – Establishment of reporting procedures and management of quality records.



# CQMS and CPWQ

- Construction Quality Management System is referred to as CQMS
- System for monitoring ongoing project management.
- It provides direction and assesses the management team's of a construction project.
- Steered by SOP's, also known as Big Q.
- Some organization used ISO 9001 / CIS 29 as their standard format of QMS.
- Construction Product and Workmanship Quality is known as CPWQ.
- It is a quality of the workmanship and product of the construction.
- Steered by Work Method Statement, also known as Little q.
- Organization will use contract documents (consists of Specification and Drawings) as their method of evaluation.
- Some organization use QLASSIC as additional evaluation format of the contractor's workmanship as required by regulator body (e.g. CIDB)



Consequently, Construction Quality Management System (CQMS) and Construction Product and Workmanship Quality (CPWQ) are two distinct scopes.

# CQMS & CPWQ

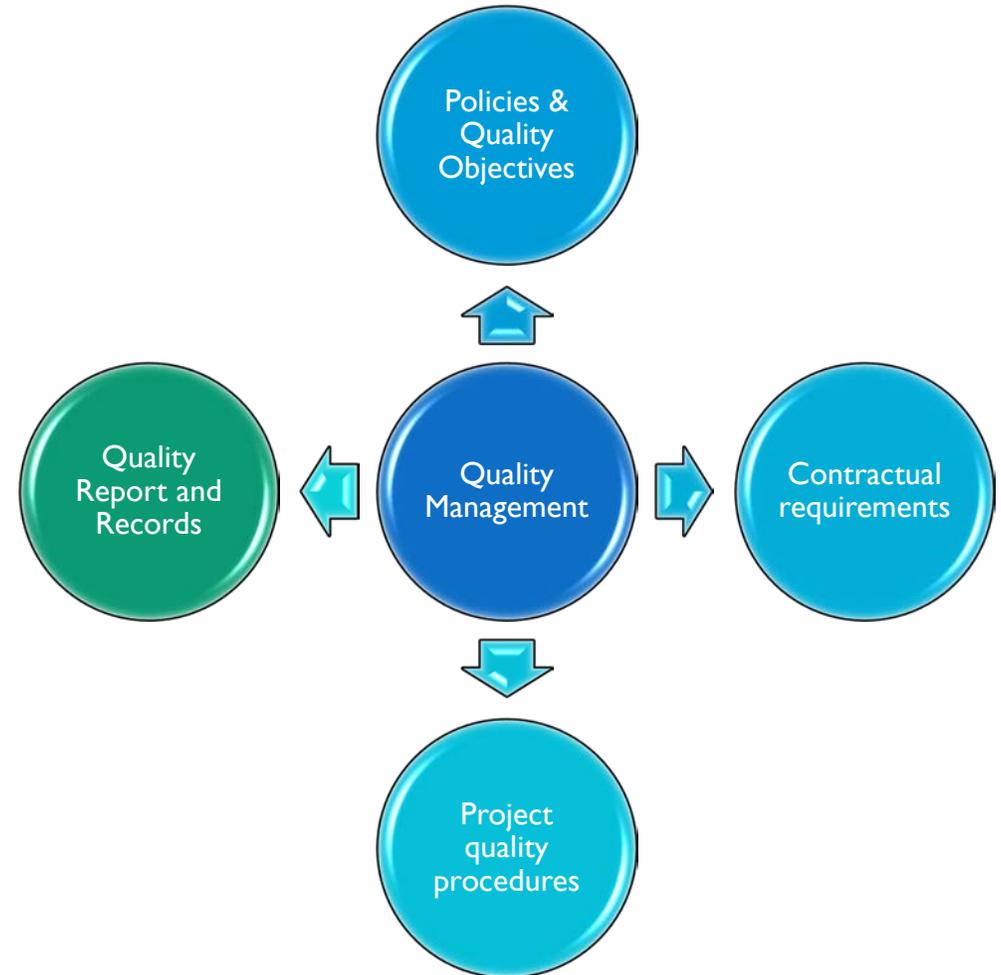
An experienced contractor may use best practices to ensure the quality of their work and product installation, but they are not experts in management systems, and vice versa.

In typical Malaysian custom, for a major construction project, a main contractor with exhaustive knowledge of QMS will be appointed and managed a group of specialist sub-contractor in their trade of works.



# 4 Pillars of Construction Quality Management

## Pillar I – Policies & Quality Objectives



# Policy and Objectives

Policy and Objectives is part of Performance Management to identify **what we want to achieve for the whole project** and **what we have achieved so far**. It can be used for ISO 9001, CIS 29 compliance and performance measurement by HR department for career development (e.g., KPI).



Goal Deployment that been set-up by top management



Identification of Critical Success Factor (CSF) for the projects

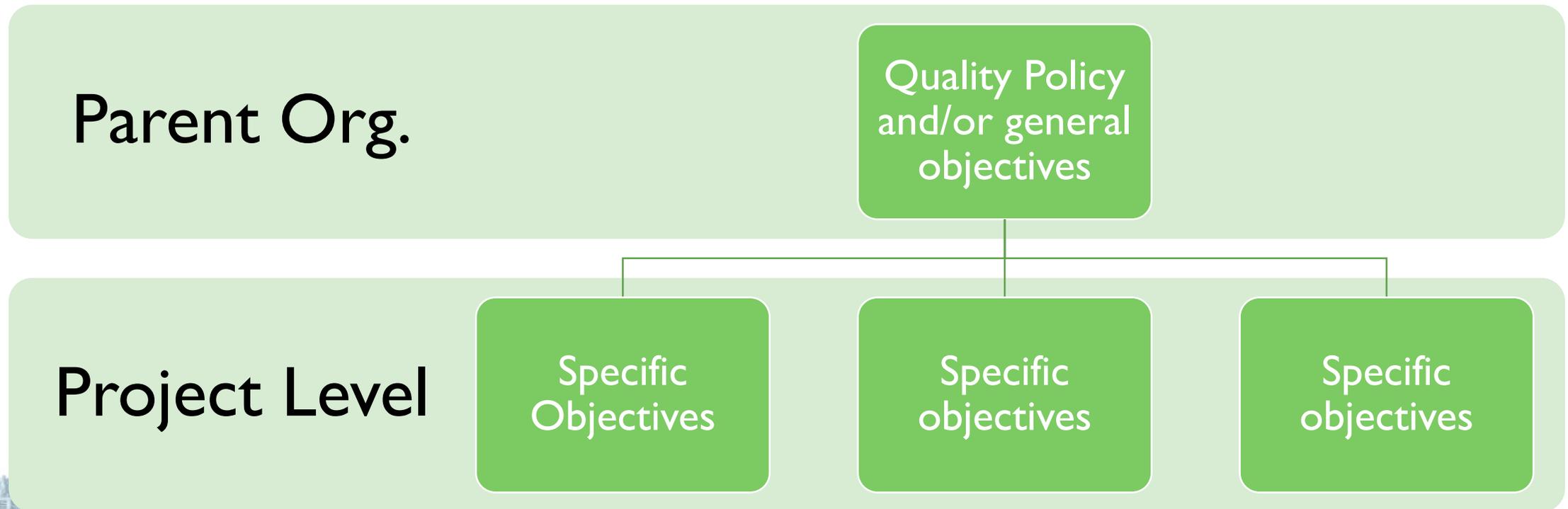


Project Objectives



Records of achievements

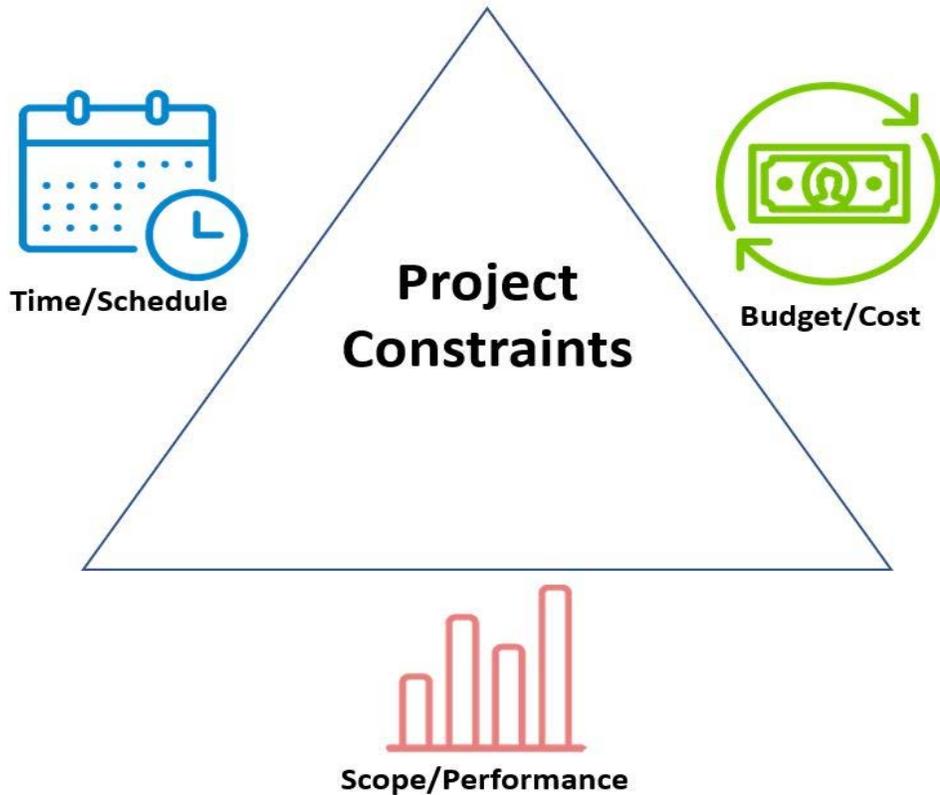
# Policy and Objectives frameworks



# How to set Project Objectives



- Basic requirements for project objectives shall include 3 infamous project constraints :-
  - Within allocated time (no delay)
  - Within allocated budget
  - Within scope/performance/deliverables required in the contract documents.
- There is no number agreed number for objectives, however an organization is advised to established  $\pm 5$  objectives.



# How to set Specific Project Objectives



- Let say, an organization has set-up his primary/general objectives is :-  
**“To complete the project within time as specified in the contract”**
- Therefore, project team shall establish specific project objectives. The best and advisable specific objectives shall content these 4 elements :-
  1. Criterion – on what criteria that a project shall achieves (e.g. as per general objectives)
  2. Goal – what we want to achieve (e.g., within time schedules)
  3. Tolerance limit – to give acceptable variance in achieving the objectives (e.g., within 10% variances in delay from the time schedules)
  4. Evaluation – to give comparable evaluation on the achievements (e.g., within 10% variances in delay from the approved time schedules)

And the specific objectives shall be :-

**Within 10% variances in delay from the approved time schedules**

# Sample for Construction Project Objectives

To ensure that all public and client complaints are resolved within adequate time.

To ensure resources availability and reviewed before work commencements.

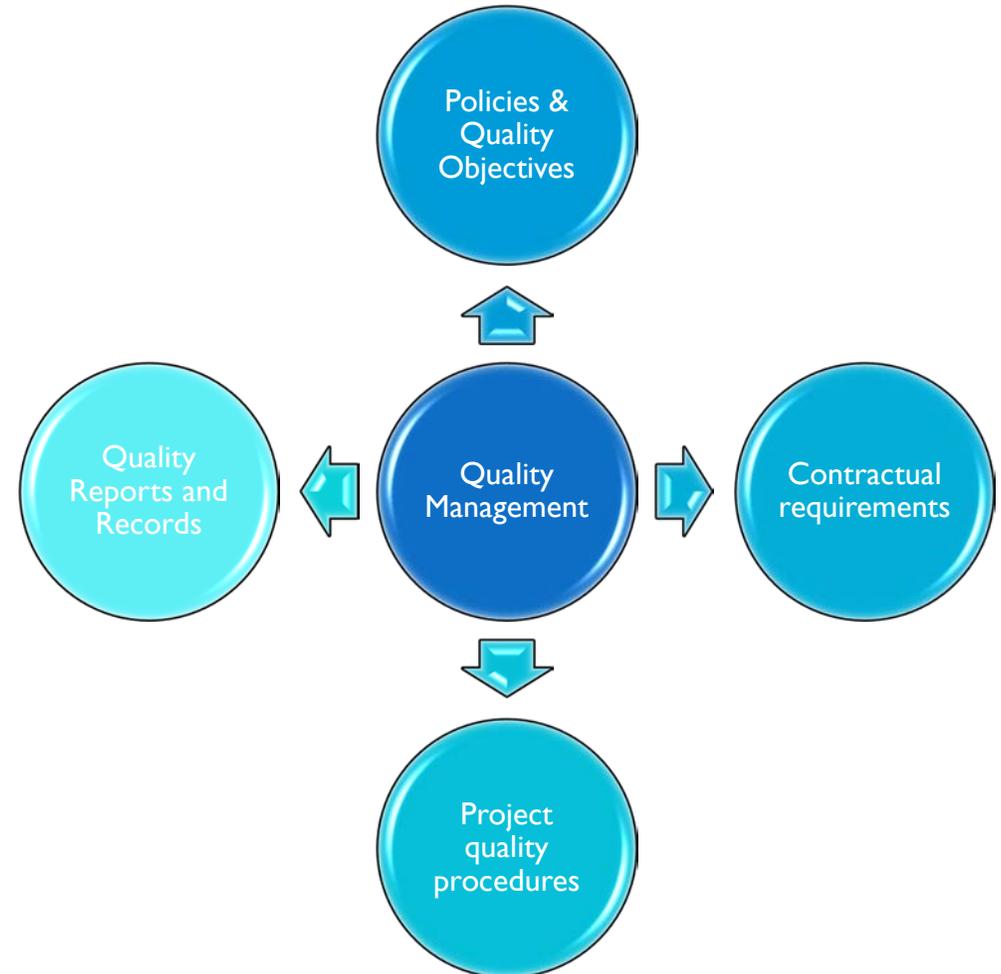
To ensure that project are done within time.

To ensure that competencies of personnel conducting the works are reviewed and updated from time to time.

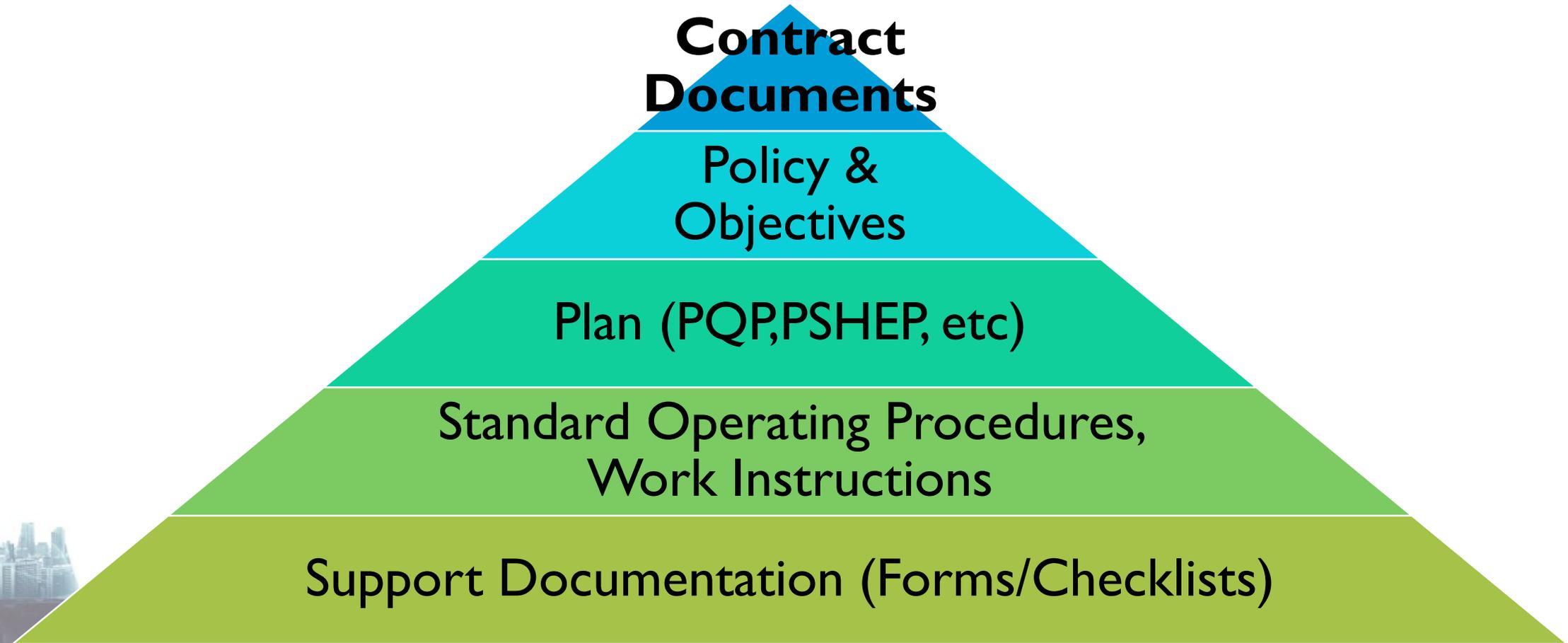


# 4 Pillars of Construction Quality Management

## Pillar 2 – Contractual Requirements



# Hierarchy of Documents Level in Construction Site



# Type of Standard Form of Contract Document in a Construction Projects

PAM 2018	CIDB	JKR	FIDIC
Letter of Award	Articles of agreement	Form of tender	Contract agreement
Articles of Agreement	Letter of award	Letter of acceptance of Tender	Letter of acceptance
Conditions of Contract	Conditions	Contract Drawings	Letter of Tender
Contract Drawings	Addenda to conditions	Bills of Quantities	Particular Condition Part A – Contract Data
Contract Bills	Drawings	Specifications	Particular Condition Part B – Special Provision
Other documents	Specifications	Treasury's Instructions	General Condition
-	BQ or schedules of work	Other listed documents	Specification
-	Other documents	-	Drawings
-	-	-	Schedules

# Contract Documents



- Contract Documents usually made up by standard forms of contract widely used in most of the construction project in Malaysia, namely PAM Contract, JKR Form, CIDB Standard Form and FIDIC. Usually the forms consists of:-
  - Article of agreements
  - Condition of contract,
  - Construction Drawing
  - Specification
  - BQ/Schedule of rates
- Therefore, Contract Documents form basis of overall quality management system in a certain construction projects.
- The contractor shall construct and complete the works in accordance with Contract Documents (construction drawings, specifications, BQ, etc.) and provide adequate manpower, machinery, materials, and method to construct and complete the works.

# Trivia for Contract Documents

- Usually the Specification/Standards use **complete predicate** sentences, which means that it consists of **subject**, and **predicate** which consist of **modal verb**, **verb**, **noun** and **adverb** and **adjunct**.

*The Contractor shall implement, observe and maintain a Quality Assurance Plan, which shall, as a minimum, at the requirements set out in ISO 9001:2015....*

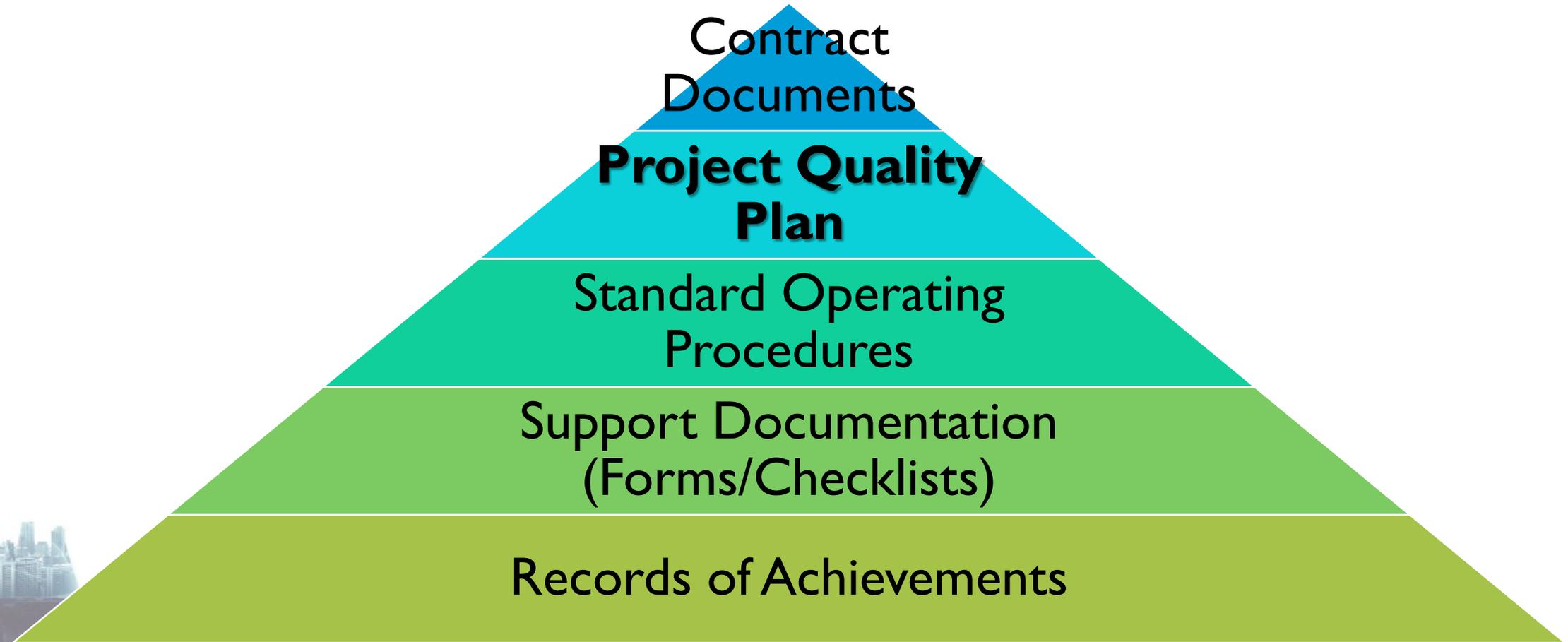
*The Contractor shall be responsible for the design of concrete mixes and for ensuring that all concrete placed in the Works meets the requirement of this Specification.*

Subject	Predicate			
	Modal Verb	Verb	Noun	Adjunct
Contractor	Shall, can, may*	Plan, implement, conduct, improve, observe, maintain etc	Design mix , Plan	To emphasize why and how it shall be done.

\* when Contract documents (Specification/Drawings) mention these words :-

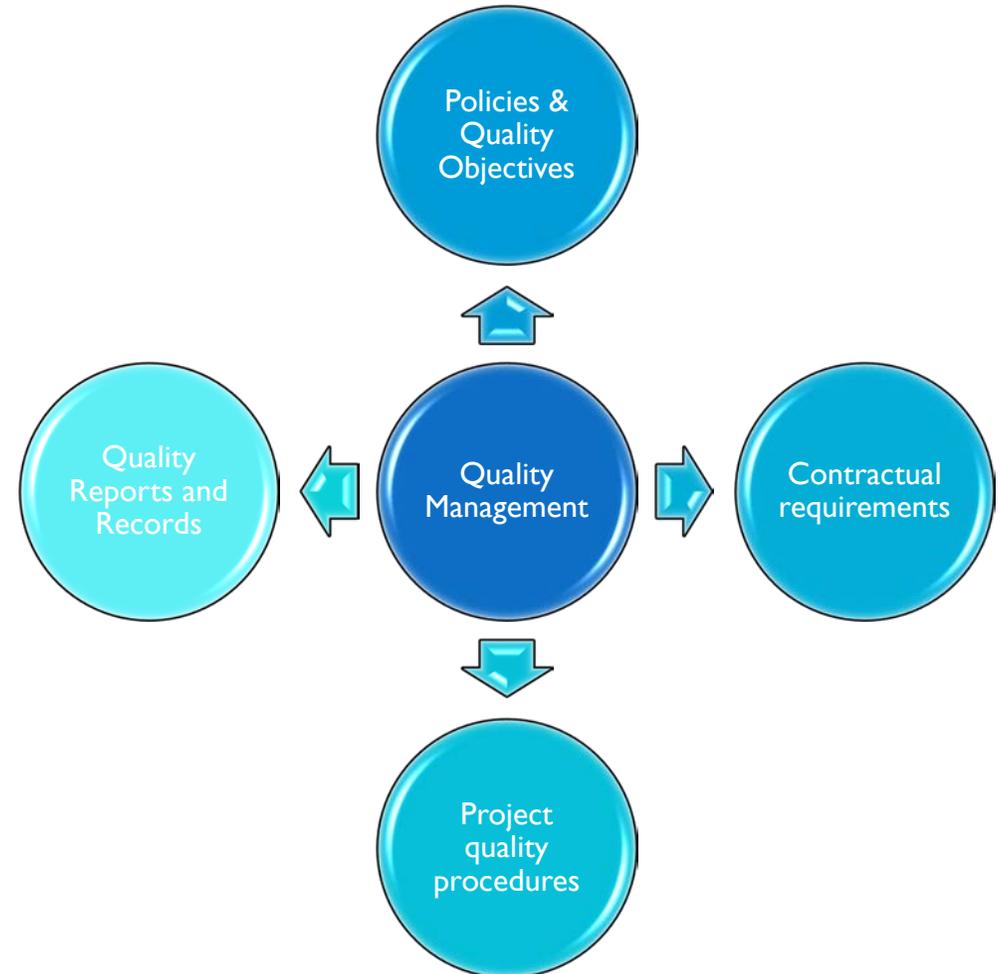
- Shall – means that it is compulsory to do by contractor.
- May – contractor may do it but must obtain approval by client.
- Can – contractor are allowed to do.

# Hierarchy of Documents Level in Construction Site



# 4 Pillars of Construction Quality Management

## Pillar 3 – Project Quality Procedures



PQP shall be submitted by the contractor if any part of the contract documents requires it.

PQP is the overall plan for quality management system of the project, and it provides an agreed method between contractor, consultant, and client on the SOP to manage quality for the overall project.

PQP shall demonstrate how contractors plan for their QMS throughout the project period, how to manage their planning, and how to control it.



# PQP content

- PQP requirements are varies from one contract to another, some contract requires the PQP to be done by using ISO 9001 model, some the contract provide in detail what are requirements that the contractor shall provide inside PQP.
- But basically, PQP contents are based on 4 main pillars of quality managements :-
  - Quality Policy and Project quality objectives.
  - Identification the scope of contractual requirements for the project.
  - Identification, establishments, upkeeping the quality procedures for the projects.
  - Type of quality reporting and quality records.
- PQP Publishers may also refer to **ISO 10005 – Quality Management – Guidelines for Quality Plan** for an overview of overall PQP structures.



# Hierarchy of Documents Level in Construction Site



# Standard Operating Procedures

- PQP alone is insufficient to ensure that everyone is familiar with the system; occasionally, PQP is paired with SOP to enhance the method for controlling quality between all parties (contractor/consultants/client) in conducting daily tasks (mostly related to document management).
- We require SOP for all iterative work, including inspection and testing, processing of submittals, etc. SOP can aid us as a standardized, agreed-upon method for processing work on site.
- SOP shall be able to tell every activities what is the work, who shall do it and how many days shall it takes to complete each task....



# SOP's format



SOP can be in point form

1. Before concreting, make sure all surface are clean.
2. Inspection will be done with IOW.
3. After approval, the concrete will be ordered.

Or, in flow chart form



# SOP – The concept of Big Q and Little q

Big Q	Little q (Work Method Statement)
SOP for Inspection and Testing	Method Statement for Piling
SOP for Contractor Claims	Method Statement for Concreting
SOP for Material Handling	Method Statement for Brickwork
SOP for Vendor appointment	Method Statement for Plastering

- This (Q and q) concept was introduced by Dr. Joseph M. Juran in 1980 to differentiate between **business process** and **manufacturing / construction process**.
- PQP and SOP are produced to show how we control the Big Q process, including method to control little q process. Usually, little q process are being described in **Work Method of Statements**.



# SOP

- Method of Statement (small q) is difficult to specify in this programme due to the fact that method statement submission requirements vary by activity type and trade.
- However, for Big Q (construction management's SOP), the number of SOPs that must be established depends on the contract itself (normally specified in the preliminary item); however, if not specified, ISO 9001/ CIS 29 provides guidelines regarding the number of SOPs that may be established throughout project period.
- In addition according to Abdul Razzak Rumane, in his Book Quality Tools for Managing Construction Project (2010) recommended that there shall be around 20-30 SOPs for a construction projects, whatever sizes and trade.



Normal  
SOP's for  
construction  
projects.

SOP	Purpose
Project Organisation Structure	Establishment of Org Chart, Job Description and Awareness & Competencies program. What to do when new person joint in.
Inspection and Testing	Procedure for submitting ITP, ITP format, Inspection procedures, archiving of inspection records.
Plan submission	How many plan in a construction, preparation, review and approval, and also Sub-Contractor procedure.
Submittals	Type of submittals, review process including timeline, who shall review etc.
Technical Query	Reviewing timeline, process feature, etc
Appointment of Sub-contractor/Vendor	Method to appoint sub-contractor, criteria to look for and evaluation of sub-contractor/vendors
NC Management	How to manage NCR, issuance and closing of NCR.
Document Management	Correspondence management, archiving and retrieving
Drawings management	How many types of drawing expected to be handled by contractor, distribution process, etc.
Meeting	Meeting matrix, minutes of meeting format, distribution of meeting minute

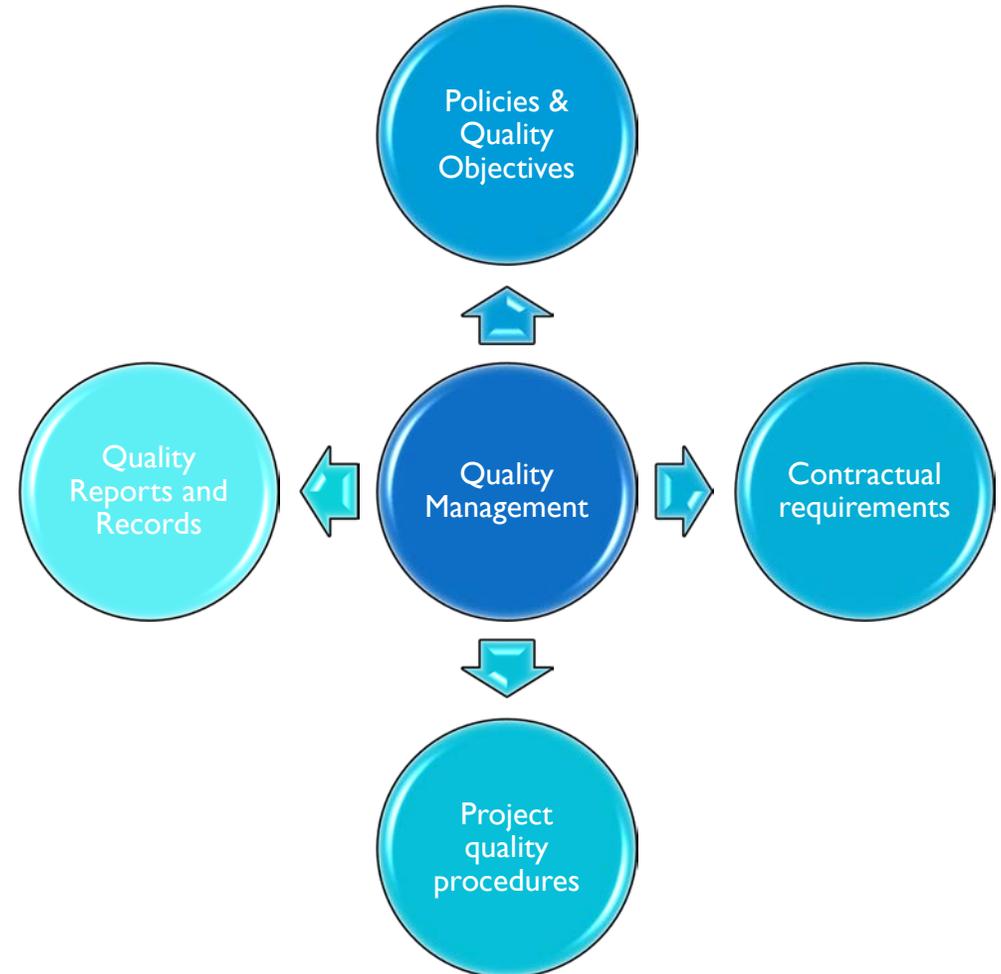
Normal  
SOP's for  
construction  
projects.

SOP	Purpose
Audit	How to manage audit programme and reporting procedures
Crisis Management	If receive complaints from public, regarding any issue, how to handle it.
Customer Satisfaction	Method to evaluate customer satisfaction and improvement.
Emergency response Team	What is the procedure if accident happen in project site.
Procedures for Handing over of projects	What are the document required to handing over, how to inspect final defect before handing over, what type of defect can be considered minor defect/major defect.
Procedures for Defect Management	What we need to managed defect after project completion during DLP, who to manage and how if defect found.



# 4 Pillars of Construction Quality Management

## Pillar 4 – Quality Reports and Records

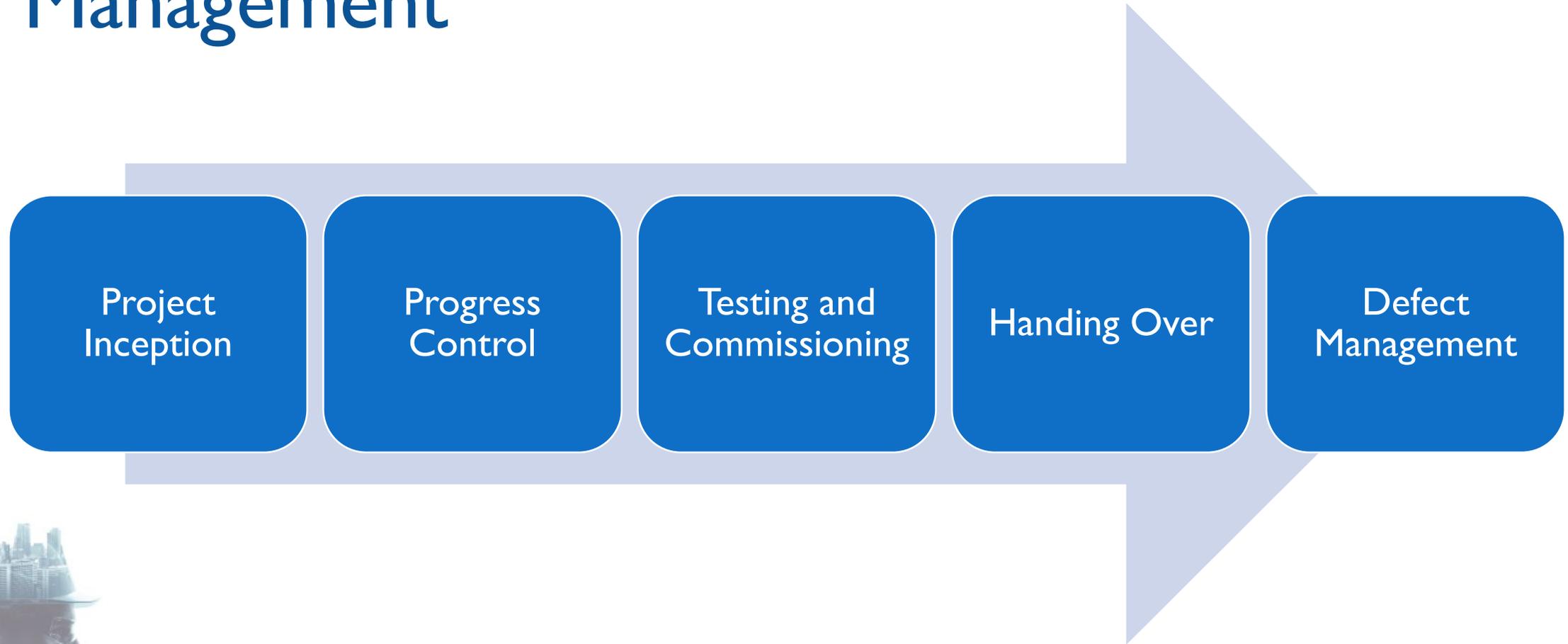




# Hierarchy of Documents Level in Construction Site



# Lifecycle of Construction Projects Quality Management



# Type of Reports and Records

No.	Type	Sample
1	Plan	PQP, PSHEP, EMP, ESCP, etc..
2	Reports	Progress Report, Quality Report, Safety Reports, NCR, Audit report, Evaluation reports.
3	Correspondence	Incoming & Outgoing Letter, Incoming & Outgoing Transmittal, Site Memo.
4	Submittals	Method Statement, Material Submission Approval, Shop Drawings, Construction Drawings (if Design & Built projects) or Draft As-Built drawings.
5	Site Records	Inspection Request forms with checklists/test results, Site Daily reports, Minute of Meetings

Before any work or portion of work can be considered complete and released, each of the previously mentioned stages must undergo three processes on-site, and each of these processes shall be documented/recorded. The three processes are :-



# Review, Verification and Validation

Review – identification and determination of the suitability, adequacy or effectiveness of an plan, product or workmanship to achieve established what it intends to be.

Verification - confirmation, through the provision of review evidence, that specified requirements have been fulfilled, and adequate resource had been provided to fulfill requirements.

Validation - confirmation, through the provision of review evidence, that the requirements for a specific intended use or application have been fulfilled and ready for handed over to client or next process.

# Review stages



- It is normal practices that Contractor shall submit to the awareness of client/client rep. for any work or part of work that the contractor intend to do, includes :-
  - Materials or part of materials to be used for the projects.
  - Machinery/Equipment to be used or to assist in the work.
  - Manpower that will be involved in the project (skilled/semi skilled/unskilled).
  - Method to be used to complete the work.
  - Any drawings to supplement the work (e.g., Shop Drawing, Operation and Maintenance manual)



- For a big projects, we have thousands of materials, method and shop drawing to handled, therefore it is almost impossible to communicate all this submittals (between contractor/consultant/client) via official letter or correspondence, therefore, contractor shall establish Submittals Management System.
- Contractor shall design SOP's on how this submittals will be submitted for approvals, some of the info required in the submittals are:-
  - What type of submittals (Method Statement/Material Submission/etc)
  - What is the form of submission, using what format.
  - How long shall CA review? (7 days/14 days/28 days, mentioned anywhere in contract?)
  - If rejected, how long shall contractor respond.
- The most usual type of submittals includes :-
  - Shop Drawings.
  - Method of Statements
  - Material Approvals
  - Inspection & Test Plans
  - Draft As-Built drawings.
  - Etc as agreed in PQP.

1. Project  
2. Ease of  
3. Easy for  
site.

# How long shall client/client rep. review submittals (Material Submission, Method Statements, ITP etc)?



Proposal by (suggested by)	How many days
FIDIC	14 days
Journal <b>Attitudes of People in The Construction Industry Sector on Issues Related to Delay in the Approval of Submittals</b>	7 days
Article <b>Shop Drawings and Other Construction Submittals: Legal and Engineering Perspectives</b> - Brown, James C. & Cavaluzzi, Gerard P.	14 days

Most references indicate that the actual response time is dependent on the size and type of the submission, as well as the contract specifications.

Therefore, the contractor shall begin submissions at least two cycles of approval prior to the start of work. (e.g., if the requirements specify 14 days, the contractor must submit one month in advance.)

In a research conducted by Dr. Chang Sun Ching of the University of Wisconsin, client (or Consultant) , on average, evaluate contractor submissions within 28-30 days at USA.



# Inspection & Test Plan

- Instead of submitting mentioned submittals, the contractor also shall submit an ITP that specifies which activities are required for achieving joint inspection contract conformity.
- It specifies the responsibilities for carrying out the activities, the regulating specifications, drawings, etc., the documents governing them, and the required records. These are drafted to support the Contract Quality Plan for a specific portion of the works.



# INSPECTION AND TEST PLAN

## SUMP PUMP

ITP No. ITP/PL/03  
 REVISION No. 01  
 PAGE No. 1 OF 1

**Project :**

S. No.	ACTIVITY	PARTIES INVOLVED	ACCEPTANCE CRITERIA	VERIFYING DOCUMENT	RECORDING DOCUMENT	INSP. & ACCEP.			REMARKS
						SUB	MC	CN	
<b>1.0 DOCUMENT REVIEW</b>									
1.1	Review the technical submittal related to Sump Pump	CN	Project Specification	Manufacturer Technical submittal	Material Submittal	R	R	H	
1.2									
<b>2.0 MATERIAL RECEIVING</b>									
2.1	Inspection of sump pump as per approved material submittal	CN / QC	Technical Specification	Related Material Submittal	Material Approval Request (MAR)	H	S	W	
2.2									
<b>3.0 INSTALLATION</b>									
3.1	Inspection for the installation of sump pump as per drawing	SE/QC	Construction as per drawings	Related Drawing & Manufacturer instructions	Inspection Request	H	S	W	
3.2	Inspection for the connection of pumps with piping	SE/QC	Construction as per drawings	Related Drawing & Manufacturer instructions	Inspection Request	H	S	W	
3.3	Inspection for the connection with valves & related accessories	SE/QC	Construction as per drawings	Related Drawing & Manufacturer instructions	Inspection Request	H	S	W	
3.4	Inspection for the electrical connection of Sump Pump	SE/QC	Construction as per drawings	Related Drawing & Manufacturer instructions	Inspection Request	H	S	W	
3.5	Inspection for the installation of identification tags	SE/QC	Construction as per drawings	Related Drawing	Inspection Request	I	S	S	
<b>4.0 PRE-COMMISSIONING &amp; COMMISSIONING</b>									

- There are 2 common responsibility for Contractor/Consultant which is :-

	Contractor	Consultant	Sample of work
Any work that contractor shall seek approval before proceed with next sequence of work	Hold (H)	Approval (A)	Any close off work, such as concreting, backfilling or etc that after the work completed, Inspector are unable to inspect
Any work that contractor can proceed without consent of IOW, IOW needed for standing supervision of the work.	Surveillance (S)	Witness (W) /	Any ongoing work, where Inspector can check on the final output, such as excavation, drilling.



# Verification Stages



# Verification Stages

- Once all submittals reviewed and approved, contractor can commence work at site.
- 4 elements of inspection are :-
  - Material – as per approved material.
  - Manpower – the right person to do the work as per proposed in the method of statements.
  - Machinery/Equipment – as per approved (sufficient, adequate and inspected)
  - Method – as per agreed method and workmanship as per requires in contract documents.
- Inspection also shall cover safety, environmental, and risk of this 4 elements.
- Usually contractor will use form like Inspection Request or popularly known as RFInspection or RFWork Inspection.



# Validation Stage



- The difference between verified and validate is that verified means that the work has been completed in accordance with the method statements or any submitted proposals, whereas validate means that all testing and commissioning have been passed and the product and work are ready to be handed over.
- Validation includes :-
  - Conduct completed test (28 days test cube, etc.)
  - Conduct overall Testing and Commissioning
  - Inspection of G Forms CCC
  - Inspection of work handing over.





# Quality Management System Models





# ISO 9001:2015



- ISO 9001:2015 is the most common Quality Management System that widely used in all industries in the world.
- It provides an organisation with a set of requirements for managing quality throughout the certification period.
- This method of managing quality may already be in place in the organisation; however, the auditor's present during the audit period to ensure that the system is run in accordance with ISO 9001 requirements.
- There are seven clauses in which an organization shall provide evidence of accomplishments ,context of the organisation, leadership, planning, resources, operation, performance management & Improvements.
- It also give guidelines for establishments of PQP, and planning for overall quality management in a project.
- The advantage of ISO is that it is well-known and simple to apply, even for newcomers; however, it is not construction-specific.



- CIS 29: 2021, also known as the Contractor's Quality Management System (CQMS), was introduced by CIDB in 2021.
- This standard is applicable to contractor on voluntary basis. CIS 29 is more tailored to Malaysia's construction industry.
- It is appropriate for all contractors, regardless of whether their company has an ISO 9001 certification or not.





# ISO 9001 and CIS 29

ISO 9001	CIS 29
International recognizable	Established in Malaysia for Malaysian contractor's environment.
General requirement	More focused on construction sector
Establishing SOP's is not compulsory but advisable	Some SOP's are compulsory, and the standard provide 26 guidelines on how SOP shall be established.
Using PDCA Approach Plan – Clause 4,5,6,7 Do – Clause 8 Check – Clause 9 Act – Clause 10	Using scope approach Section 2 – General Management Requirement Section 3 – Construction Management Requirements
Does not recognize local law	Familiar with local statutory and regulatory law
Cover organizational process	Cover organizational and project lifecycle

# BS 9900 I – Built Environment Quality Management

- British Standard Institute launches the standard in July 2022 with a focus for built environment quality assurance.
- The certification is not for the company but for the project that the firm intended to apply for because BS 9900 I is focused on projects while ISO 9001 is focused on company QMS.
- This ISO 9001 extension requirements include
  - Clear identification of management rep. to authorize SWO if any quality/safety or other issue is not addressed;
  - competent person serving as project management representative.
  - ITP enforcement;
  - design and management of temporary work.



## Competencies level to be QMS Personnel in Construction

- At the moment, there isn't currently a set of requirement/competencies set for QMS professionals in Malaysian construction from any regulatory agency.
- However, it is advised that anyone planning to work in quality assurance or control (QA/QC) have a basic understanding of QMS, such as ISO 9001, CIS 29, or any QMS standards for QA part and understanding of work process and acceptance criteria for the work that he/she involved in for QC part.

# What is next?

## Industrial Revolution 4.0 (9 pillars of IR4.0)

- Autonomous robots
- Simulations
- Cybersecurity
- Cloud Computing
- Internet of Things
- Big Data Analytics
- System Integration
- Additive Manufacturing
- Augmented Reality

# Cloud Computing, Big Data Analytics, Internet of Things, System Integration

- Currently, some Malaysian projects are utilizing cloud servers and integrating the system with AutoCAD, Revit, and other engineering software.
- Software like Aconex, Procore, Fieldview, Novade, and many others can integrate with other software like Primavera and AutoCAD to ensure that information completed by other organizations are well-aware to other members of the project team.
- BIM (as an example) can integrate some of construction software such as Revit, AutoCAD and many more.



# Q & A





# THANK YOU



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