



CONSTRUCTION SUPERVISION

GUIDELINES

VERSION 1.1

UNOPS Construction Supervision Guidelines

Version 1.1

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List of Abbreviations

UNOPS Abbreviations

CSG	Construction Supervision Guidelines
DPM	Deputy Project Manager
EOD	Executive Office Direction
EOI	Executive Office Instruction
HR	Human Resources
IPMG	Infrastructure and Project Management Group
OI	Operational Instruction
PMM	Project Management Manual
PM	Project Manager
QATL	Quality Assurance Team Leader
SMF	Standard Management Framework
UN	United Nations

Other Abbreviations

AASHTO American Association of State Highway and Transportation Officials

ACV	Aggregate Crushing Value
AIV	Aggregate Impact Value
ASTM	American Society for Testing and Materials
BS	British Standards
CBR	California Bearing Ratio
DB	Design and Build
EBI	Evidence-Based Infrastructure
ERP	Enterprise Resource Planning
ESIA	Environmental and Social Impact Assessment
FIDIC	The International Federation of Consulting Engineers
FI	Flakiness Index
GCC	General Conditions of Contract
GPS	Global Positioning System
HSSE	Health and Safety, Social and Environmental
IC	Implementation Consultant
ISO	International Organization for Standardisation
ITP	Inspection and Testing Plans
LAA	Los Angeles Abrasion

MORSS	Minimum Operating Residential Security Standards
NC	Non-conformance
NCR	Non-conformance Report
OHSAS	Occupational Health and Safety Advisory Service
O&M	Operations and Maintenance
PPE	Personal Protective Equipment
QAP	Quality Assurance Plan
QA/QC	Quality Assurance and Quality Control
QA	Quality Assurance
QATL	Quality Assurance Team Leader
QC	Quality Control
SEMP	Social and Environmental Management Plan
SSS	Sodium Sulphate Soundness
TFV	Ten percent Fine Value
TOR	Terms of Reference
NDSS	United Nations Department for Safety and Security

Acknowledgments

PROJECT TEAM

The UNOPS Construction Supervision Guidelines is a product of collective hard work and dedication. The following people were part of the project team that developed 'Version 1.0' of this publication:

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How to use this guidance

This publication forms a part of the UNOPS Infrastructure and Project Management Group (IPMG) Standards Management Framework (SMF) and should not be applied in isolation, but with consideration for related normative and informative publications within SMF. Furthermore, this publication requires a thorough understanding of the UNOPS Organizational Directive (OD) on the Management of UNOPS Partners and Resulting Agreements and the relevant accompanying Organizational Instructions (OI).

As with each publication that forms part of the IPMG Standards Management Framework, this publication considers the particular needs of the user. The design facilitates its usage, readability and navigation.

TARGET AUDIENCE

The target audience for the Construction Supervision Guidelines are, but not limited to, UNOPS Infrastructure Practitioners, Project Managers, Team Leaders, Project Engineers, Construction Supervisors, Works Inspectors, and Technicians who will be responsible for the day-to-day quality assurance activities for construction delivery of infrastructure assets and/or systems.

CALL-OUT BOXES

Call-out boxes highlight important information in the form of figures and definitions, key messages, examples and case studies, considerations, and references to additional information.

FIGURE / DEFINITION

This box contains a figure, box (text and figures combined) or definition.

KEY MESSAGE

This box contains a key message.

EXAMPLE

This box contains an example.

CONSIDERATION

This box contains a consideration.

MORE INFORMATION

This box contains more information.

1. Introduction

The Construction Supervision Guidelines is intended to impart knowledge and recommended good practices for effective construction supervision on infrastructure construction projects.

1.1 General

UNOPS Infrastructure and Project Management Group (IPMG) recently promulgated the Operational Instruction (OI) for Construction Supervision ([OI. IPMG.2018.06](#)) to provide mandatory instructions for construction supervision for delivery of construction related projects.

The Construction Supervision Guidelines (CSG) supplements the OI and to be used, along with other related publications, quality assurance templates and project specific documents. The publication forms part of IPMG's cascaded publications within the [Standards Management Framework \(SMF\)](#). These include the Project Management Manual (PMM), PMM Extension, Project Management perspectives and other infrastructure related guidances, etc. This collection of integrated publications is designed to contribute to the overall organization performance on effective infrastructure project management.

The overarching objective of this series is to establish consistent and effective project management practices that will help to mitigate and/or reduce infrastructure project risks, thereby enhance successful delivery of infrastructure projects to the required performance targets for time, cost, quality, scope, benefits, and risks.

DEFINITION

Construction supervision refers to all activities and services relating to the technical supervision of construction, reconstruction, demolition, repair or renovation of infrastructure works; which may include any combination of civil, mechanical, electrical, sanitary and/or any related construction works.

1.2 Purpose

UNOPS established a series of Design Planning Manuals to ensure that designs fulfils minimum quality requirements for safe and functional infrastructures. In this connection, in spite of robust designs and specifications, infrastructure construction can go wrong due to inadequate construction Quality Assurance and Contracts Management activities. This is in terms of broadly effective **Quality Management, Health, Safety, Social and Environment, Contracts Management and Project Controls**. This Construction Supervision Guidelines, therefore, intends to guide project team to implement infrastructure constructions in strict accordance with technical designs and specifications and reasonable professional judgment.

Effective construction supervision practices can mitigate and/or reduce construction implementation risks thereby help to ensure successful delivery of infrastructure assets and/or systems that are fit for purpose.

1.3 Structure

In addition to the introduction section, there are two main sections - Section 2: Infrastructure Asset Life Cycle and Section 3: Construction Supervision Guidance.

Section 2 provides an overview appreciation of an Infrastructure Asset Lifecycle and the various significant interdependencies and considerations relevant to construction supervision.

Section 3 is the main section of the publication which details the core aspects of construction supervision through four main thematic areas and/or categories:

- . Quality Management
- . Health & Safety, Social & Environmental Management (HSSE)
- . Contracts Management
- . Project Controls

2. Infrastructure Asset Life Cycle

In order to successfully achieve both the intended output (infrastructure asset) and the intended outcomes it is essential to consider the whole life cycle of the asset.

A standard infrastructure asset lifecycle includes four key generic phases that broadly cover the planning, implementation, and usage aspects of an infrastructure asset as represented graphically in **Figure 1: Typical Infrastructure Asset Life Cycle** (p. 13) and discussed in the following section. **Figure 2: Impact on usage (O&M)** (p. 13) depicts the importance of the initial phases over the final phase. Pre-investment (Feasibility), Design and Construction which takes places over comparatively shorter period of time impacts the Usage period which extends over a longer time duration. Construction Supervision which is a key activity during the Construction phase has significant influence on the Usage period and hence is recommended to be carried out with right approach, attitude and commitment.

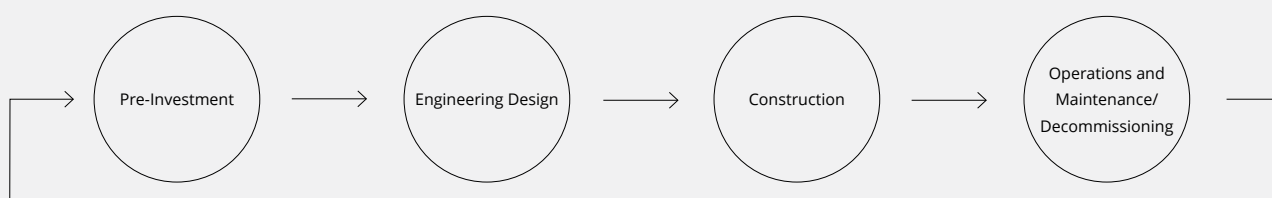


Figure 1: Typical Infrastructure Asset Life Cycle

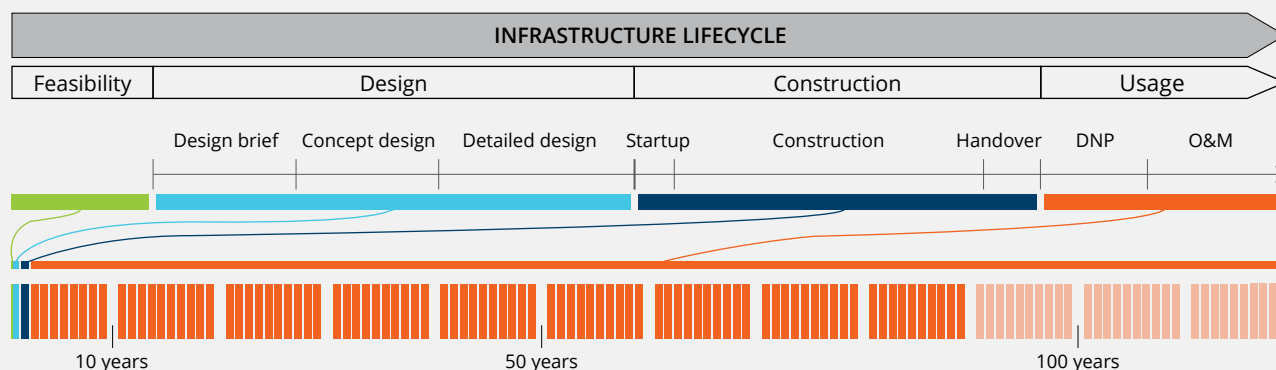


Figure 2: Impact on usage (O&M)

2.1 Pre-investment Phase

Infrastructure is a key driver to economic and social development that is intended to positively change the lives of people. As most infrastructure development and usage involves significant investment, robust pre-investment studies should be undertaken to determine the feasibility of the investment. The initial study should be conducted in terms of commercial, technical, social, environmental, institutional, political and financial viability.

Proper project formulation, evaluation and prioritization at the outset are key to sustainably achieve long-term project objectives. The pre-investment phase squarely serves this very purpose.

Technically, this phase is the 'concept' or 'feasibility study' phase where the client and/or donor will be provided with objective data and evidence as well as alternative options. This will provide the information needed to make an informed investment decision on whether to go ahead with the detailed planning and development of the project or stop the project if the feasibility study shows the project is not viable against key dimensions. For infrastructure projects, this phase requires an adequate level of desk review and technical field studies to develop a comprehensive feasibility study. The study should include the cost-benefit analysis (economic appraisal), social and environmental impact assessment, preliminary engineering designs, timelines, cost estimate, key project development, and implementation risks etc.

Unfortunately, UNOPS is not usually involved in this fundamental decision making phase. Funding sources or clients usually initiate the vast majority of infrastructure projects and make an investment decision based on strategic objectives and/or priorities. Funding sources or clients approach UNOPS at a later stage to begin the implementation of the project. However, UNOPS is working strategically to proactively change this status quo.

One corporate priority for UNOPS is to start providing strategic solutions to partners by engaging at a higher level and participating in their strategic and planning discussions and decisions. By engaging higher in the value chain there will be a better chance for UNOPS to propose comprehensive solutions that can sustainably address the challenges and bring about a tangible outcome and benefit. As part of this corporate strategy, UNOPS advocates a new holistic approach to infrastructure development; planning, decision making and implementation that is based on reliable evidence and transparent investment business cases. The new approach will help essential infrastructure systems become more effective, sustainable and resilient.

KEY MESSAGE

In the world of limited resources and competing priorities, it is not only important to be 'doing projects right' but also to be 'doing the right projects'.

MORE INFORMATION

The Evidence-Based Infrastructure (EBI) publication ([see the page on the UNOPS intranet](#)) provides an in-depth explanation on the overall EBI Framework.

2.2 Design Phase

Physical infrastructure requires an appropriate level of technical design that commensurate the level of risk and complexity of the work. The purpose of this is to ensure that considerations surrounding life safety, functionality and serviceability of the infrastructure asset have been addressed accordingly to applicable design standards and codes.

The level of design studies, details, applicable regulations, codes and standards to be used are usually stipulated in the partners' core project requirements, also known as the Terms of Reference (TOR). Technically, design inadequacies and/or flaws are one of the top causes of scope creeps, budget over-runs, time over-runs, and, in some cases, health and safety hazards during construction and usage. Therefore, it is important that an appropriate level of effort, time and resources are applied to complete technical designs with reasonable skill and duty of care.

The first and key planning stage in design management is defining the requirements. These include:

- Design scope
- Applicable regulations, Standards and codes
- Performance and/or conformance requirements (functionality, serviceability, safety, sustainability)
- Design period/ or Design Service life
- Development skill required
- Key design inputs
- Review points or stages
- Key timelines
- Milestones
- Deliverables

This information is usually captured through the design brief document or TOR. The design brief is a key baseline document against which design development progress, and design quality will be measured and reported.

The main source of design requirements or solutions in the design brief, in the order of priority, are applicable local, national, regional, and/or international design regulations, codes and standards identified in the Engagement Agreement, Consultancy Services Contracts or Design and Build Contract, Terms of Reference (if any) and UNOPS Design requirements.

It is a design standard requirements that designs should be completed with reasonable skill and duty of care, and fit for purpose. Designs should pass through also a rigorous design review process as part of design development quality management. In this regard, UNOPS established a **mandatory independent and objective design quality review process** through the OI on Design Reviews of Infrastructure Work.

KEY MESSAGE

It is vital that the initial design planning be as thorough and comprehensive as possible. Failure to incorporate key design considerations upfront may have time and cost implications during construction and result in lost opportunities for improved infrastructure outcome. The famous MacLeamy curve advocates front loading design effort in order to reduce costly changes later once the design develops and/or construction commences.

MORE INFORMATION

The reference for the Operational Instruction on Design Reviews of Infrastructure Work is [OI.IPMG.2018.03](#). It includes the mandatory independent and objective design quality review requirements and process.

2.3 Construction Phase

In the majority of UNOPS infrastructure projects, the construction, related construction management and quality control activities are carried out by the Contractors. The contractors are generally procured by UNOPS through a competitive bidding process, except Contractors pre-selected by the funding source.

The role of UNOPS during the constructions phase is mostly limited to construction supervision, quality assurance activities and Works Contracts management. Additionally, there are a number of cases where UNOPS procures external engineering companies (Supervision Consultants) to carry out technical construction supervision tasks on behalf of UNOPS. However, the Consultants, are delegated with limited authority relating to some key contractual aspects such as: determination of claims, variations, issuing contractual notices and certification of payments.

In some cases and depending on the project local context, UNOPS provides Direct Implementation of Construction whereby UNOPS assumes the overall responsibility of establishing the quality assurance and quality control (QA/QC) systems and carry out the construction to the required quality standards. Generally, the role of UNOPS in this case is of direct control, assurance and general oversight of the Works implementation. IPMG is currently developing further guidelines on Direct Implementation.

KEY MESSAGE

Construction of infrastructure asset and/or system is carried out in accordance with the design, specifications, bills of quantities, conditions of contracts and other requirements collectively called 'The Contract Documents'

2.3.1 Contracts Management

Contracts Management refers to all actions undertaken after the award of a contract through a procurement process. It includes administrative aspects of the contract, such as:

- Contract amendment
- Contract closure
- Record retention
- Maintenance of the contract file
- Analysing and determinations of claims
- Receiving and issuing notices
- Monitoring performance
- Expenditure and reporting
- Handling of security instruments (e.g. performance security)

UNOPS has developed a suite of General Conditions of Contract (GCC) based on standards from International Federation of Consulting Engineers (FIDIC). Each one has been especially adapted for use in UNOPS common infrastructure projects and take UNOPS operating environments, privileges and immunities as a UN entity into account. The GCC includes:

- Contracts for Consultancy services for Works (FIDIC white book equivalent)
- Measured Price Construction Contract – (FIDIC Red Book equivalent),
- Short Form Construction Contracts (FIDIC - Green Book equivalent)
- Minor Works Construction Contract and (Based on FIDIC- Green Book)
- Lump Sum Construction Contract (Based on FIDIC Red Book)
- Design and Build Contract (FIDIC Yellow book equivalent)

The GCC along with other technical documents that form the contract are the core legal and binding documents to administer the contracts in the day-to-day execution of professional services and works contracts. They also serve as a base reference for any contractual disputes or claims.

MORE INFORMATION

The OI on UNOPS Works Contracts ([OI.IPMG.2018.07](#)) provides instructions regarding the use of UNOPS Works Contracts when implementing Works for or on behalf of UNOPS. The CSG and forthcoming Works Contract Management Guidelines supplement the OI.

Robust Contracts Management is instrumental to mitigate organizational risks and liabilities associated with non-performance and breaches of contract.

2.3.2 Testing and Commissioning

The testing, commissioning and acceptance of infrastructure assets and/or systems is an integral part of the construction phase. Well-planned and effective commissioning processes and activities as well as a thorough exit strategy are crucial to appropriately transfer liabilities and assist the beneficiary or client in use of the asset. This is in terms of facility requirements, such as operation and maintenance, staff training, energy efficiency, operating environment, etc., which are mostly overlooked.

UNOPS Works Contracts specify Tests on Completion in addition to the routine testing and inspection that are usually carried out as part of the wider quality management activities during the construction phase. Adequate planning for this the testing and commissioning phase is a vital activity that will help to ensure successful completion. It is recommended that planning for this activity should be considered at the same time as the preparation of the tender documentation.

Typically, the commissioning and handover process should provide to the client/users documentation and records on the design, construction, and testing to facilitate operation and maintenance of the infrastructure asset and/or system.

2.4 Operation and Maintenance Phase

It is imperative to consider operations and maintenance (O&M) during the design and construction phases, however all too often it is ignored as this lies outside of the scope of typical UNOPS engagements. Good practice dictates that O&M must be considered and that effective measures are put in place to ensure O&M are managed across the lifecycle of the infrastructure asset.

UNOPS can contribute by inclusion of O&M deliberations at the outset and influence to the extent possible on O&M policy priorities for sustainability of the impact /value of infrastructures. Production of O&M manuals and provision of related trainings should be a compulsory requirements in the Contract Documents to help the O&M and usage of the infrastructure asset and/or systems. In this regard, the Construction Supervision team should make sure that the Contractor produces the O&M manuals including As-Built Drawings and provide related client/users trainings.

KEY MESSAGE

The inclusion of O&M considerations has the potential to create a long-term positive and direct impact upon the sustainability and resilience of the infrastructure asset and/or system created.

3. Construction Supervision Guidance

Construction supervision requires adequate level of effort and resources that commensurate the nature, complexity and risk level of the infrastructure construction activities.

3.1 Works Implementation Modalities

Depending on UNOPS roles and responsibilities, and rights and obligations for the overall delivery of quality through management and assurance activities, there are common works implementation modalities *with varying scope and roles of construction supervision*.

1. **Works Contract Modality:** this is the common works delivery approach where the Contractor(s) is/are responsible for the overall quality control systems. While UNOPS is responsible for quality assurance functions. Under this modality, there are three implementation approaches that change depending on the contractual role of UNOPS:
 - a. **UNOPS as Employer and Employer's Representative:** Where UNOPS enters in to a Works Contract with a Contractor to deliver the Works
In this case, UNOPS personnel (the Country Director or Procurement Authority, or Hub Director) with appropriate Delegation of Authority enters a legal agreement with the Contractor and subsequently assumes the role of the Employer on behalf of UNOPS. UNOPS's technical personnel under the overall direction of the Employer's Representative (the Project Manager) will carry out the construction supervision activities. The Employer's Representative has clear duties and delegation of authorities from the Employer.
 - b. **UNOPS as Employer:** Where UNOPS enters in to a Works Contract with a Contractor to deliver the works, and also enters into a Contract for Consultancy Services for Works with a third party to act as Employer's Representative
In this case, UNOPS (the Employer) nominates a supervision consultant through a contract for Consultancy Services for Works to act as the Employer's Representative (the Engineer in FIDIC terminology). Within the terms and conditions of the service agreement the supervision consultant team will be responsible for the overall quality assurance of onsite activities. In a third party construction supervision modality, it is a recommended industry practice that the supervision consultants are required to develop comprehensive QA/QC plans appropriate to their duties and delegations of authorities stipulated in the service contract. This requirement needs to be included as one of the evaluation criteria in the solicitation documents for procuring Contracts for Consultancy Services for Works.
 - c. **UNOPS as Employer's Representative and Partner(s) as Employer:** in this case the Partner enters a Works Contract with the Contractor and nominate UNOPS to manage this contract on their behalf.
Under this model, UNOPS will be appointed by the client or funding source as the Employer's Representative. UNOPS's technical personnel are led by the UNOPS Project Manager and will execute and supervise the contract(s)

on behalf of the Employer's Representative. This model may or not be subjected to a formal notification of duties and authorities between the UNOPS Employer's Representative and the UNOPS technical staff.

2. **Design and Build Contract:** The Design and Build (DB) contract (FIDIC Yellow Book equivalent) is currently under development. The core feature of this contract is the single point of responsibility in which the single prime contractor will be solely responsible for all services necessary for design and construction of the infrastructure assets and/or system as per the Employer's Requirements stipulated in the tender documents and resulted approved design and specification. It is important to note that there may be other sub-contractors working for the prime contractor who may or not have been novated to the prime contractor by the client, donor and/or UNOPS.

In this case, the Employer's Requirements are a performance specification leaving the means of achieving the final output(s) to the discretion and expertise of the DB contractor. Under this type of contract, UNOPS supervision will consist of a QA function only. This is to ensure that the prime contractor is delivering the infrastructure asset and/or system in accordance with the approved designs and specifications. Extreme caution and guidance is required during the use of this type of contract.

3. **Direct Works Implementation:** in this infrastructure implementation modality, UNOPS will assume the overall responsibility of establishing the QA/QC systems and carry out the construction to the required quality standards. Generally, the role of UNOPS is of direct control, assurance and general oversight of the works implementation.
4. **Labour Based Construction Methods:** this approach mainly deploys community based organizations from the local area to support construction of low-risk infrastructure assets. This approach forms part of capacity building and national ownership endeavours. UNOPS will have the overall guidance and quality oversight role to train and mentor the workforce deployed in the labour based construction.
5. **UNOPS as Implementation Consultant:** UNOPS acts as an implementation consultant (IC) to partners and provides technical advisory and/or assistance services. Partners are fully responsible for design and construction of the works either through an in-house team and/or third party consultants and contractors procured through its own procurement rules and regulations.

EXAMPLE

- a) UNOPS office in Afghanistan (AFOC) provides technical assistance to the country's Ministry of Public Works. Support includes project management, infrastructure, procurement and financial management related to design, procurement and construction of transport infrastructure projects being implemented by the Ministry. (Project ID 20910-001)
- b) UNOPS Jerusalem Office (JMOC) provides legal, financial and technical (QA/QC) assistance in Gaza. This directly benefits households in the re-construction of homes destroyed by war (Project ID: 21353-001).

Summary of the various implementation modalities discussed in this section along with corresponding Quality Management roles of each party in a construction project is included at **Annex A: Quality related Roles for Works Implementation Modalities (p. 61)** in a tabular representation.

KEY MESSAGE

The principal feature of DB contract is the 'single point of responsibility' in which the Contractor provides both design development and construction services to the Employer.

KEY MESSAGE

It is essential when using Direct Implementation model to consider and make formal arrangements to ensure separation between UNOPS team conducting QA and QC functions, to avoid risk of conflict of responsibilities and/or interest that may negatively impact quality of the Works.

3.2 Construction Supervision Principles

In accordance with the OI on Construction Supervision ([OI.IPMG.2018.06](#)), the key construction supervision principles, tailored to UNOPS project context, are:

Clear Definition of Roles, Responsibilities and Liabilities

The Project Manager (PM) shall be responsible to ensure that effective construction supervision is in place at all times during the implementation of the works. The PM shall also ensure that the roles, responsibilities and associated liabilities in each of the contract modalities, listed in **Section 3.1**, are clearly defined in the applicable agreements and in the Project Plan (Baseline).

Risk Based Approach

Construction supervision activities shall be delivered through a principled approach that supports the effective delivery of infrastructure works, and the reduction in risk associated with the implementation of infrastructure. UNOPS personnel carrying out construction supervision activities for or on behalf of UNOPS shall refer to the OI on Project Management ([OI.IPMG.2018.01](#)), the PMM and related guidance materials as well as the HSSE management framework.

Construction Supervision in Accordance with Agreements and Delegation of Authority Framework

- Construction supervision shall be done in accordance with applicable agreements, in particular the Works Contract between the Employer and the Contractor, and the contract between the Employer and the Employer's Representative.
- The authority of the Employer and the Employer's Representative shall be compliant with the relevant UNOPS Delegation of Authority framework.
- The specific duties and authority attributable to each party under the above agreements shall be reflected in the Project Plan (Baseline).

Resources

- Appropriate resources shall be allocated to meet the technical and logistical supervision needs of the project. The level of required resources shall be determined by the nature and the complexity of the works and reflected in the Engagement Agreement. The Employer's Representative (or the UNOPS personnel responsible for supervising the works implementation in the case of Direct Implementation) shall have the appropriate logistical support to discharge their duties.
- Should remote monitoring procedures be proposed for the project, these shall be defined within the Project Plan (Baseline) and shall recognize risk, constraints and mitigation measures required to ensure the contractually required quality of work is achieved and the required construction standards are observed.

Communication and Reporting Requirements

- Management mechanisms developed within the Project Plan (Baseline) shall identify appropriate lines of communication. The Employer's Representative (or the UNOPS personnel responsible for supervising the works implementation in case of Direct Implementation) shall be provided with effective communication Equipment and have the ability to report to the Employer (or the Engagement Authority in the case of Direct Implementation) as required.
- Reporting requirements shall be defined and executed in line with the Project Plan (Baseline) in accordance with the reporting requirements set out in UNOPS applicable policies, the applicable agreements and the needs of the project.
- Where incidents relating to Health, Safety, Social and Environmental (HSSE) matters occur, these shall be reported in line with EOI.CSG.2017.02 on Reporting and Management of Health & Safety and Social & Environmental Incidents.

Site Related Monitoring and Evaluation

- The Employer's Representative (or the UNOPS personnel responsible to supervise the works implementation in the case of Direct Implementation) shall monitor and assess the implementation of the works and, in the case of non-conformity, take appropriate remedial actions in accordance with applicable UNOPS policies and agreements, as well as the Project Plan (Baseline) and any associated sub-plans, including the health, safety, social and environmental management plan.

Records

- The Employer's Representative (or the UNOPS personnel responsible to supervise the works implementation in the case of Direct Implementation) shall ensure that an accurate daily record is kept for all works and activities carried out on site.
- Details shall include, but not be limited to: mechanized equipment and labour levels, deliveries of materials and plant, weather conditions, working hours, trade related activities, quality management activities, photographs, health safety and environmental activities along with details of any non-conforming issues arising.
- Contemporary records shall also be made, including records of any specific discussions, instructions, phone calls or written communication to or from key stakeholders.
- All records shall be stored in the project files and also in the online UNOPS document archive.

Feedback, Improvement and Lessons Learned

- The Employer's Representative (or the UNOPS personnel responsible to supervise the works implementation in the case of Direct Implementation) shall report to the Employer (or the Engagement Authority in the case of Direct Implementation), at intervals prescribed within the applicable agreements and the Project Plan (Baseline), examples of good practice or activities that could contribute to the adjustment and strengthening of project control.

The above mentioned construction supervision principles are embedded and described in the construction supervision thematic areas explained in subsequent sections.

3.3 Typical Construction Supervision Team Structure and Roles

Construction supervision requires adequate level of effort and resources that commensurate the type, size, complexity and risk level of the infrastructure construction activities. Therefore, the construction supervision team need to have the required qualified personnel with relevant expertise and experience and necessary tools and instruments to carry out their duties effectively.

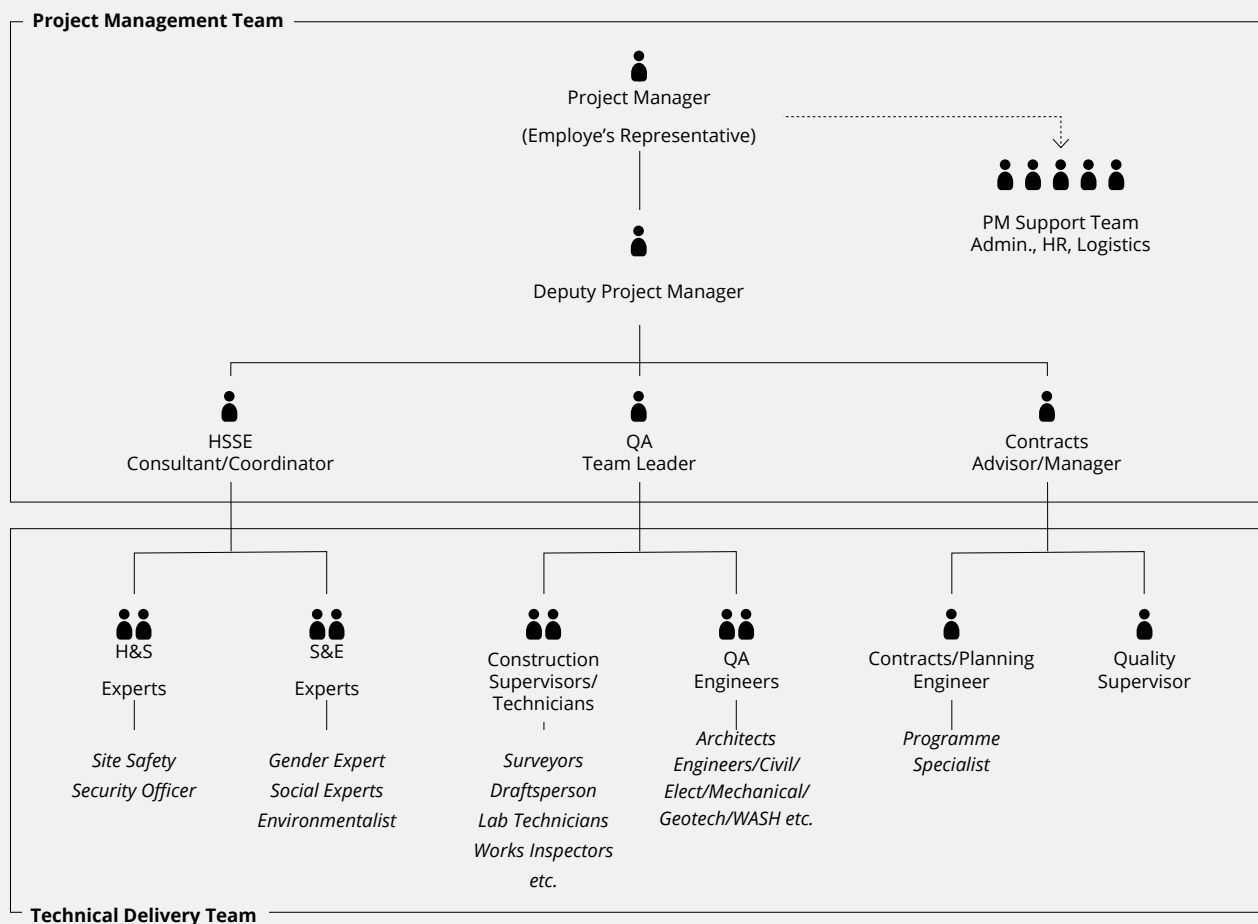


Figure 3: Typical Construction Supervision Team Structure

Project Manager

The Project Manager (PM), supported by key project management and technical delivery team members, will have the ultimate responsibility with respect to the overall construction activities and achievement of project objectives. In UNOPS project context, the PM is accountable to the Project Board Executive.

In UNOPS Works Contract terms the PM assumes the Employer's Representative role. Unless the Employer's Representative assign duties and delegate authority to the Deputy PM or QA Team leader, the PM is typically the only delegated authority by the Employer to issue written instructions, notices, determinations, approvals, certification, etc. to the Contractor in relation to the execution of the Works. The PM has limited delegated authorities, for instance the PM does not have authority to amend the contract and related documents, such as quality requirements and acceptance criteria, and waive the Contractor from any of its obligations and liabilities under or in connection with the Contract.

CONSIDERATION

Roles can be combined depending on the skillset and workload (example: The QA Team Leader can take also the DPM role)

Some resources may have intermittent/part-time role (retainers or HQ experts - HSSE Experts, Contracts Advisor) depending on the scale and complexity of the Construction

However, the PM can, and is reasonably expected to, propose value engineering changes to the contract requirements for the Employer's approval if the proposed change improves quality, provides cost savings and expedite progress.

Deputy Project Manager

The Deputy Project Manager (DPM), through delegated authorities from the PM, may have the overall responsibility to assign roles and responsibilities to each supervision team member and also carry out performance monitoring and evaluation of the team.

In contract terms, the DPM generally assumes the Employer's Representative's Assistant role and will lead and coordinate all the technical activities and site operations of the Construction supervision team. The PM may also delegate specific project management roles such as stakeholder management to the DPM.

The DPM should develop and issue a list of duties and responsibilities to the team members as well as expected deliverables such as site daily diary, progress reports, inspection and testing reports, measurement sheets, submittal review reports, site records, incident reports etc.

With the support of the QA team leader, the DPM will lead development and maintenance of the project Quality Assurance Plan (QAP) that includes necessary templates, checklists and tools. The QAP will be the guiding baseline and procedure for the overall quality management activities by the construction supervision team. The QAP should be aligned with the Works Contract quality requirements, particularly the specifications, and construction specific information from the overall project Quality Management Plan.

Quality Assurance Team Leader

The Quality Assurance Team Leader (QATL) provides overall coordination and guidance to the construction supervision team to effectively carry out quality assurance activities. The QATL also provides necessary expert advice to the PM for an informed decisions making related to the overall QA activities. The QATL should review and monitor the QA/QC activities to ensure:

- Necessary quality process is adhered to
- Inspections and testing are performed as per the approved inspection and testing plan and contract requirements
- Specified inspection and testing techniques and standards are used
- Specified requirements in the contract for quality control and acceptance of material and workmanship are enforced

The construction supervisors, engineers and technicians who will be carrying out on site day-to-day QA activities will report and be accountable to the QATL. The team makeup in terms of size, required cross-functional expertise and experience shall be updated by the QATL to suit the type, complexity and level of effort required to deliver the construction quality assurance activities.

HSSE Coordinator

Infrastructure implementation requires significant effort to make sure that the health and safety of the workforce, public and all persons directly or indirectly associated with the construction works are not endangered during the construction of the infrastructure asset and/or system. In addition, there is a need to mitigate or reduce risks and adverse impacts on the social and natural environment as a result of infrastructure development.

The HSSE Coordinator role on infrastructure construction supervision is a key resource to ensure HSSE considerations and effective HSSE management are taken into account. This role is also key in the establishment and monitoring of a grievance mechanism. This will allow communities to raise any concerns or

complaints about the projects' environmental and social performance. Social and Environmental sustainability is a critical priority and is a precondition for successful infrastructure development, operations and maintenance.

Key responsibilities include but is not limited to:

- Provide technical advice and oversight on HSSE aspects
- Help the site team with the development, review and approval of the Contractors' Health and Safety, and Social and Environmental Management Plans
- Review and provide feedback on HSSE performance report
- Periodically monitor and audit HSSE management activities
- Establish and monitor community grievance mechanism
- Provide training and mentoring of the construction workforce and stakeholders including communities
- Analyse and report construction site incident reports along with remedial and/or preventive actions

Depending on project size, complexity and HSSE risk level this role can be permanent (full-time) or shared (part-time) resources with intermittent input.

Contracts Manager or Advisor

The Contracts Manager or Advisor will provide technical advice and support to the Employer's Representative on key contractual matters such as variation orders, claims analysis and determination, disputes, termination etc. The Shared Services Centre at UNOPS HQ provides some operational support and expert advice, however it is beneficial to have that function at a project level for larger projects that may need more continuity of management and advice.

Technical Delivery Team Members

The preceding roles are supported by a wide range of technical delivery roles. The level of support depends on the scale and complexity of the project. It is recommended to be careful when considering team size, specifically in areas that include remote and/or multiple sites. This is due to increased travel factors. Technology based solutions for remote inspection or management of sites do not replace physical presence on site as an effective solution. It can assist but should not be proposed to solely deliver construction supervision activities.

KEY MESSAGE

In addition to specified quality requirements **sound engineering practices and professional judgment** cannot be overemphasized for robust and cost effective quality management.

3.4 Scope of Construction Supervision

The following key thematic areas broadly constitute standard construction supervision aspects for both permanent and temporary physical infrastructure construction works

- Quality Management
- Health & Safety, Social & Environmental Management
- Contracts Management
- Project Controls

3.4.1 Quality Management

Quality Management for physical infrastructure projects is all about ensuring that they are fit for purpose. To guarantee that each infrastructure asset and/or system is completed to the specified level of quality, and when placed in operation, provides a safe, sustainable, reliable, easily maintainable facility that fulfils the intended function and meets applicable statutory and regulatory requirements. This requires a robust quality management plan (QMP) appropriate to the type,

nature, complexity and risk level of the infrastructure project.

The core purpose of the QMP is to detail how the quality processes for a project will be implemented to ensure that the project outputs meet the clear requirements and are delivered fit-for-purpose. The quality management process should be instituted at every phase of the infrastructure asset's lifecycle – Pre-investment (Feasibility), Design, Construction including Testing and Commissioning (Handover) and Operations & Maintenance.

Quality Management for infrastructure projects is the centre of all the key project performance targets and applies to all the key thematic areas. These include: Design Management, Resource Management, Scope Management, HSSE, and each of project formulation and implementation stages. The PM is required to ensure that the quality of individual outputs at each delivery stage is achieved while adhering to the other target constraints of scope, time and cost.

The QMP for infrastructure projects broadly contains appropriate quality planning or quality requirements, QA and QC plans which will be the guiding baseline and procedures and instructions for the overall quality management activities.

The quality planning is usually completed at the pre-construction stage to clearly specify the overall project quality requirements. This also helps contractors take the expected level of quality efforts into account during the bidding process. This is in terms of time and resources to construct, test and commission the works.

The QA and QC plans are developed based upon the requirements for quality and approach to delivery. These plans must be adhered to during implementation of the works.

3.4.1.1 Basic Quality Related Concepts

Quality

The desired function or purpose of an infrastructure asset and/or system broadly includes, but is not limited to, the strength, capacity, durability, serviceability and maintainability, but also an extra but important element of *sustainability and resilience*.

The project contract documents, particularly the technical specifications and drawings, clearly stipulate and classify the desired function as captured from the client's strategic brief and/or project core requirements. However, it is not uncommon to see errors, omissions, discrepancies or unrealistic time and cost constraints that result in inadequate definition of the desired functions. As a result, the specified process or product will not match the anticipated functions. On the other hand, requirements may be overly specified to achieve the desired function.

In this case, reasonable professional judgement shall be used to scrutinize the specified functional requirements and propose fit for purpose and economical design and/or construction solutions.

EXAMPLE

In strict accordance with the applicable design standards for a **local roads** project (AADT =< 400), the culverts (buried structures) are required to be designed for A SERVICE LIFE (working life) of 120 YEARS. In this regard, despite this project specific standards/ quality requirements the design decision may need to be critically assessed by the Design Practitioner and appropriate design working life be determined with due consideration given for, amongst other things, functional requirements, financial and practical feasibility, **if the culverts are to be replaced due to future upgrades of the local roads to trunk roads after 30 years**. In such cases professional judgement is warranted to avoid over specified and costly design.

CONSIDERATION

As an aspect of Quality Management, this publication deals mainly with UNOPS QA role in a Works Contract Management environment. This means infrastructures are designed by UNOPS and/or third-party Design Consultant(s) and constructed by a construction contractor(s) through Works Contract between UNOPS and the Contractor(s).

EXAMPLE

A bridge contractor should know at the tender stage if there is a need to perform static and dynamic load tests (Tests on Completion) before opening of the bridge for traffic.

DEFINITION

For the purpose of this publication quality is broadly considered as the process (such as quality standards procedures), inputs (such as materials, workmanship, plants and equipment) as well as the output (end product such as the building, or the wind turbine, or culverts etc) of the works to achieve the desired function or purpose of a particular component or totality of an infrastructure asset and/or system.

Quality Assurance, Quality Control and respective roles

The UNOPS Works Contract states that the onus rests with the Contractor(s) to produce work which conforms in quality and accuracy or detail to all the requirements of the Specifications, Drawings and any relevant documents specified in the Contract. The Contractor(s) shall, at their own expense, establish an approved quality control system and provide appropriate expertise, as required by the UNOPS-partner agreement and/or works contract.

UNOPS, through its in-house QA team or third party supervision consultants, shall check that the Contractor(s) and Sub-contractor(s) consistently adhere to QC process and system and that the quality requirements for the project are being achieved.

The QC activities are carried out through routine inspection, measurement and testing on materials, workmanship and completed works. Tests are conducted using specified standards, codes and testing and inspection plans. The Works Contract typically includes requirements for comprehensive testing and inspection plans which UNOPS construction supervisors verifies during quality assurance activities.

Quality Requirement Categories

Quality assurance and control activities require a reasonable level of time and resourcing. The contract documents should clearly specify and capture quality requirements, controls and the level of effort required for the necessary QA and QC activities.

For infrastructure works implementation, quality requirements broadly include input requirements (*material, workmanship, and equipment requirements*), *process requirements*, and *output requirements*.

- **Process Requirements**

Strict adherence to specifications, standards and regulations in terms of material sampling, testing, mixing, compaction, curing, bar bending etc.

EXAMPLE

If the Contractor uses welding instead of splicing of reinforcement steel bars, use of hand mix concrete instead of plant mix concrete, etc. Such a change in the specified process or methodology may have a bearing on the quality of the output and hence should be reviewed and approved.

- **Material Requirements**

Sampling, testing, inspection and monitoring of construction materials being used for incorporation in the permanent and temporary works. This includes cement, gravel, reinforcement bars, bitumen, scaffoldings, etc.

EXAMPLE

If the Contractor uses timber props for scaffolding instead of steel tubing.

- **Workmanship Requirements**

Inspection, testing and measuring of workmanships such as surface finishes.

EXAMPLE

Dimensional tolerances for form work placement.

DEFINITION

As per ISO 9001 2015 definitions:

Quality assurance consists of that “part of quality management focused on providing confidence that quality requirements will be fulfilled.”

Quality control is that “part of quality management focused on fulfilling quality requirements.”

DEFINITION

Quality of product or Output versus Quality of the Management Process

Quality of the output is the evaluation of whether or not the completed infrastructure is fit for purpose. It is the ultimate measure of the success of the asset.

Quality of Management process or system is the organizational structure supported by the managing capability of the expertise involved implementing the system. The Quality of the Management process is equally important and mostly a pre-requisite for successful delivery of quality output

- **Equipment Requirements**

The type of equipment and tools being used should be checked against the specification and vetted.

EXAMPLE

If the Contractor prefers to use hand mix concrete instead of the specified plant mix concrete, or if the Contractor uses mechanical tampers instead of power vibrators. If the Contractor proposes to use steel smooth steel rollers only, instead of using pneumatic and steel smooth wheeled vibratory rollers for the construction of bituminous pavements.

- **Output Requirements**

Evaluate whether the project outputs are fit for purpose.

EXAMPLE

If the constructed roof pitch for a Primary Health Care Centre (PHCC) in a snowy country is not steep enough as indicated in the design to shed accumulated snowfall quickly, the roof cannot be considered fit for purpose

DEFINITION

Technical Process Control versus Product Control

Product Control is related to monitoring of the soundness of the finished work item or work component with respect to the desired function, the technical specification and engineering drawings. The **Process Control**, on the other hand, is the follow-up of the soundness of each step of the continuous production process with respect to the desired function.

EXAMPLE

- Base Course Material
 - **Product Control:** For a base course layer in the construction of a road pavement, checking and controlling the degree of compaction, the geometry such as width, surface irregularity, the camber slope and the level of the layer. All such items can be evaluated by measurements and testing.
 - **Process control:** Involves the monitoring of the materials production, stock piling, and hauling, windrowing, showering, mixing, placing and compaction activities. Process control focuses on inspection whereas product control involves measurement and in situ and/or laboratory testing.
- Reinforced Concrete Work
 - **Product Control:** Includes measurement of the compressive strength achieved at the specified number of days, consistency of fresh concrete as determined through slump test, accuracy of dimensional details of the concrete element (beams or columns or footings), etc.
 - **Process Control:** Involves the mixing, reinforcement steel bar setting, concrete pouring, maintaining the concrete covers, vibrating, curing, etc.

EXAMPLE:

Testing concrete compressive strength (product control) may show the strength of a concrete sample from a certain batch at specified days. However, unless the concrete production process is followed-up, it is difficult to determine the consistency of that batch. It is also difficult to determine adherence to the mix design proportions, surface finish (segregation may occur), concrete cover, reinforcement bar positions, or any other weak spots that can be noticed through process control during preparation and concrete casting. This could include issues with the water to cement ratio, which is critical to the durability of concrete.

The PM shall enforce an appropriate level of process control, a mechanism for approval or permit to proceed at key stages of a process (witness and hold point) and shall instruct the Construction supervision team on site about the process control and its significance.

DEFINITION

Hold Point is a compulsory verification point beyond which a work cannot proceed without approval by the Employer's Representative or Client. The work cannot proceed until the Employer's Representative and/or Client is able to verify the quality of the completed work and/or materials and releases the Hold by means of Inspection and Testing Request approval.

EXAMPLE

Approval of the base course layer before applying the Asphalt Concrete Surfacing.

DEFINITION

Witness Point is an identified point in the process where the Employer's Representative may review, witness, and inspect method or process of work. The activities however may proceed.

EXAMPLE

Continuing with the second coat of paint

Attitude Towards Quality

Once the QA/QC system is developed and initiated in the project delivery, it is the responsibility of the construction supervision team and contractors to adhere to proper QA and QC activities on the day-to-day execution of the construction activities. However, adhering to established quality systems require committed time and resources of all the stakeholders involved, particularly the supervision personnel, the contractor's management as well as the contractor's workforce.

Attitudes and commitment towards QA and QC activities from personnel are very important. In this context attitudes are defined as such beliefs and commitments of organizations and individuals towards quality. One important contributor to project success is to ensure all stakeholders believe in the project from the very start. Committed attitudes towards quality can be enhanced and/or the workforce motivated through regular quality workshops, trainings and mentoring.

EXAMPLE

The PM can organize at or before the start of the construction a quality management workshop both to the Construction Supervision and Contractor's key personnel.

Statistical Procedures

Inspection, measurement and testing require statistical practices that suit the specific case. Setting of technical specifications without clearly indicating the type of sampling, frequency of sampling and acceptance criteria can create disputes at the construction site. The technical specifications (standard and particular specifications) clearly indicate the required statistical practices appropriate for measurement and testing suitable for each quality assurance and control actions. The specifications have to be adhered to by the project team including the Contractor's and construction supervision team in the course of QA/QC activities and subsequent reporting.

The following terminologies are commonly used in statistical analysis of quality activities:

- **Lot:** A sizeable portion of work or quantity of material, which is assessed as a unit or one statistical group for the purposes of quality control. It is selected to represent material or work produced by essentially the same process and from essentially the same materials.
- **Method of Sampling:** The type of sampling to be made which may be even sampling, random sampling or selective sampling
 - Even sampling: Method of sampling that is made at even intervals or frequencies. These intervals may include batches, longitudinal length, time interval and transversal length
 - Selective Sampling: Method of sampling made to check the compliance of a specific work within a lot when the construction supervision team suspects a possible quality failure.
 - Random Sampling: Method of sampling that is made in a random selection process. This is a commonly used sampling technique.
- **Reliability or Level of confidence:** The desired result relative to quality requirements. For instance, if the reliability desired for the characteristic strength of concrete is 95 per cent, 19 of the 20 specimens tested are required to satisfy the characteristic strength. However, conducting 20 tests may not be financially or physically possible, especially on smaller projects. In this case, the characteristic strength of a certain lot is computed by employing statistical procedures, usually normal distribution on a smaller number of samples.

DEFINITION

ISO 2859 refers to 'Lot' as:

'A collection of units of product from which a sample shall be drawn and inspected to determine conformance with the acceptability criteria, and which may differ from a collection of units designated as a lot for other purposes (for example, production, shipment, etc.)'

NOTE - The term "batch" is sometimes used in lieu of 'Lot.'

3.4.1.2 Construction Quality Assurance Plan (QAP)

Under UNOPS Works Contracts, the Contractor(s) is (are) responsible for constructing the works in accordance with the requirements of the contract. The Contractors are responsible for establishing, implementing, and maintaining a quality control system to manage, control, document, and ensure that work complies with the requirements of the contract. The QC system must ensure the adequate control and assurance of quality for materials, equipment, workmanship, fabrication, and construction by the contractor and its subcontractors, suppliers, material testing laboratories, and consultants.

Independent of the Contractor, UNOPS supervision team will provide QA through routine monitoring and inspections to verify the effectiveness of the Contractor's approved QC and assure that the contract quality requirements are consistently met by the Contractor(s). Whilst contractually separated, the QA and QC tasks and systems are effectively linked together.

The QA activities carried out by the construction supervision team require structured and consistent approach. The team should create and maintain a QAP aligned with the contract requirements at the outset. This will be the guiding baseline and procedure for the overall quality assurance activities carried out by the construction supervision team.

The QAP should include, but is not limited, to the following items:

1. Quality roles, responsibilities and authorities:

There should be clear roles and responsibilities and delegated authorities entrusted to the team members to avoid duplication of efforts or conflict of responsibilities. Team members only act within their respective level of authorities to issue instructions, notices or decisions on quality matters.

2. Quality requirements and metrics:

The quality requirements include methods of testing, inspection or measurement, acceptance criteria and frequency of testing, measurement or inspection originate from the contract requirements, and any local legal and legislative requirements such as health and safety. The QAP should clearly

capture the quality requirements and specified metrics to be followed for the QA activities.

3. Inspection and Testing Plans (ITP):

The ITP is prepared for each key item or components of works. The ITP should include the type of inspection and tests, testing methods and standards, inspection and testing frequencies, acceptance criteria, required inspection and testing tools, apparatus, equipment, materials and personnel and responsibilities. The information and/or data contained in the ITP are derived from those that are approved and enforceable under the engagement legal agreement and those stipulated in the Contract Documents.

4. Process control procedures:

The QA plan should clearly indicate relevant quality assurance procedures or check points to verify that the Contractor's construction process will not impact materials and workmanship quality, or fitness for purpose.

5. Control of Non-conformance (NC):

Non-conformance Report is a key hold point for raising and recording issues that are not in line with the requirements in the contract and/or relevant statutory requirements. This includes issues relating to materials and/or workmanship, HSSE, etc. The QAP needs to describe the procedure to be followed, roles and responsibilities of raising NC issues, grading of the non-conformance, and details of corrective actions required depending on the nature and severity of non-conformance.

6. Control of inspection, measuring, testing tools and equipment, and personnel:

Construction QA activities depend on appropriate tools, apparatus and equipment for the required inspection, testing and measurement. The accuracy, dimensions and sizes of the tools and equipment are crucial to quality. The QAP should clearly indicate the standard sizes including brands (Example ASTM sieves or BS Sieves), dimensions and calibration requirements for the tools and equipment.

Quality inspection, sampling, measurement, testing, recording and reporting activities require strict adherence to specified procedures and methods. The QA activities require deploying appropriately qualified and experienced technicians and engineers.

7. Documents and records control:

Infrastructure construction projects produce a lot of management and technical documentation such as submittals, inspection and testing reports, incident reports, progress reports, etc. Structured document and record control are crucial to capture relevant project information, track changes, control versions and reference for handovers and for any claims or disputes evaluation.

8. Inspection checklists and templates:

Inspection checklists and templates provide valuable guidance and consistent procedures for QA activities and also records appropriate information. The checklists and templates need to be designed in such a way that the templates capture all pertinent information required by the contract.

Item 1: Quality Roles

Competency and adequacy of the QA personnel is one of the key elements for successful QA activities. Limiting the required QA resources to offset budget constraint or enhance savings is a common error of judgement that significantly weakens QA responsibilities and also increase risk on quality.

The composition of a typical construction supervision team, identified in **Section 3.3**, can be tailored to fit with the level of QA effort required depending on a number of factors:

Items for consideration in this include:

- **Scope:** Design complexity affecting a number of QA activities.
- **Volume:** Amount of work involved in witness and hold points due to size of asset.
- **Location:** Remote sites require more travel decreasing effective time on site if team members are not permanently on site.
- **Assessment:** Sample assessment for assurance on site is significantly less expensive than offsite, but may be to lower standard.
- Level of H&S hazard and risk and S&E impacts.

Item 2: Quality Requirements and Metrics

Poorly defined and/or incomplete quality requirements and acceptance criteria are common source of construction claims or disputes. The purpose of the construction supervision activities are to monitor and verify that output fulfils the specified quality requirements and that they are fit for purpose. Quality requirements are key driving elements to determine the scope of QA and level of effort and resources required to provide effective construction supervision function.

Quality requirements for construction are captured in the Works Contracts documents, specifically in the design, specifications, technical drawings and Bill of Quantities. The specified quality requirements are also linked with quality methods including the standards, techniques and tools to be used and acceptance criteria.

EXAMPLE

Quality requirements for reinforced concrete structural element can be the design concrete compressive strength and also the various quality requirements for the component materials - such as grading, specific gravity, Aggregate Crushing Value (ACV), Los Angeles Abrasion (LAA) and soundness of the aggregates, physical and chemical properties of cement, water, tensile and yield strength of steel reinforcement bar and also the mix proportions of the ingredients such as the water /cement ratio.

Reasonable frequency of testing, sample and lot sizes are also equally important to make sure adequate quality testing is carried out for any component of work. However, too many confirmatory tests are also disruptive to progress.

Below is a typical example of quality requirements for concrete aggregate as extracted from a sample project technical specification:

CONSIDERATION

As part of quality requirements, the quality testing methods are also equally important as in most cases determine the quality acceptance criteria. For example, the percent compaction acceptance criteria for soil embankments (roads, dams etc) vary if the testing method used is **Standard AASHTO T-99 or Modified AASHTO T-180**.

EXAMPLE

Physical Description and Requirements from Specification

- Aggregates must be clean and free from clay, loam, vegetable and organic material. A well graded crushed rock or gravel that contains both sand and stones should be used for concrete work.
- The size of aggregates should not be larger than 30 mm.
- The aggregates should be washed at least once in clean water immediately before being used in concrete production

NO.	INSPECTION AND TESTING DESCRIPTION	TESTING METHOD	ACCEPTANCE CRITERIA	FREQUENCY OF TEST
1	Grading	AASHTO T-27	Different for different nominal sizes	One sample per 1500 m3
2	LAA	AASHTO T-96	<40 to 50%	One sample per 3000m3
3	ACV	BS 812-1990	<35%	One sample per 3000m3
4	FI	BS 812-1990	<35%	One sample per 1500m3
5	Specific gravity	AASHTO T-85-94ASH	<40% for grades lower than 15	One sample per 1500m3
6	SSS	AASHTO T-104	<12%	One sample per 3000m3
7	Water absorption	BS 812 or AASHTO T182	< 2.5%	One sample per 3000m3
8	% passing 0.075mm		< 1%	One sample per 3000m3

Item 3. Inspection and Testing Plan (ITP)

The inspection and testing covered in this publication is related to mainly acceptance inspection and testing by UNOPS construction supervision team. Quality control inspection and testing by the Contractor is a separate scope with standalone activities covered under the Contractor's QC plan. In some cases for small scale and low-risk infrastructure construction the QA acceptance inspection and testing are carried out as part of QC inspection and testing by the Contractor.

One of the key roles of the construction supervision team is to ensure that the Contractor(s) perform required QC inspection and testing in accordance with the specified standards, techniques, tools and expertise. In this connection and as a starting point, the construction supervision team should carry out:

- Review and approval of the Contractors' QC plans
- Checking and approving the Contractor's inspection, testing and measuring equipment and tools including periodic calibrations
- Review and approval of the Contractors' key personnel
- Consistently evaluate and validates the Contractor's quality control activities including adequacy and capability of the resources assigned for quality activities

Typically, the inspection and testing plans cover, but is not limited to, materials and workmanship. For example, the ITP should clearly map the specified inspection, testing and measurement activities for foundation excavation work for reinforced concrete footing.

Inspection: the construction supervisor should routinely inspect the subsurface foundation material where the soil profile changes.

Testing: the required in situ and laboratory testing of the foundation material to check against specified foundation material. For example: dynamic cone penetrometer for foundation or soil characterization such as the bearing capacity.

CONSIDERATION

Wherever appropriate and when required by the contract, field trials and testing are important to establish proven methods of construction and prevent non-conformance on high risk works. For example pavement works, in-situ or offsite mass productions, piling works etc. Hence, planning for exhaustive field trials and testing worth the time and effort as it will help to ascertain consistent quality and efficiency.

Measurement: the measurement required, such as a survey measurement, at the foundation level to verify that the designed level has been achieved and gather data for the measurement and payment of works completed.

The inspection and test plans are usually supplemented by appropriate checklists and forms for recording quality activities and data. Templates that support this and other QA activities are included in Annex B.



QA Testing (top). QA Inspection (bottom)
©UNOPS/Myanmar

EXAMPLE

Inspection and Testing Plan for Concrete Aggregates - Buildings

NO	DESCRIPTION	TESTING METHOD	ACCEPTANCE CRITERIA	FREQUENCY OF TEST	TEST TO BE CONDUCTED BY	RESPONSIBILITIES	
						CONTRACTOR	UNOPS
1	Grading	BS-812	Sts. Table 4.1	One sample per 1500 m3	Approved lab	Execute	Witness
2	AIV	BS 812	<45%	One sample per 3000m3	Approved lab	E	W
3	FI	BS 812-	<35%	One sample per 1500m3	Approved lab	E	W
4	TFV	BS 812 part	>50KN for other concretes	One sample per 3000m3	Approved lab	E	W
5	%passing 0.075mm	BS 812	<4%	One sample per 3000m3	Approved lab	E	W

EXAMPLE

Inspection and Testing Plan for activities

ITEM	TASK	REQUIREMENT	REFERENCE/ SOURCE DOCUMENT	QUALITY CONTROL ACCEPTANCE CRITERIA	HOLD POINT	RESPONSIBILITY	FREQUENCY OF TEST/ INSPECTION	TYPE OF CONTROL/ RECORD PROCEDURE
1	Site handover	Hand over/ Possession of sites to the contractor	Condition of contract Su-clause X.X	N/a	Yes	PM/QA/ Field engineer	During site handover	Minutes of meeting and handover letter
2	Setting out	Setting out orientation and plan of the buildings	Approved drawings	Check against approved drawings	Yes	QA/ Field Engineer	During each setting out	RFA
3	Site clearing	Site shall be cleared of all obstructions, roots and growth, vegetation of every description, trees and saplings	Tech. spec – clause X.X	Unless otherwise specified, 150 mm top soil shall be removed from that part of the site to be occupied by the proposed buildings and for a distance of 3 meters around it and the area leveled.	Yes	QA/ Field engineer	During each clearing and grubbing	RFA
4	Level checks	Before any excavation is commenced, the levels of the surface after removal of top soil shall be agreed by the field engineer and the contractor	Tech spec – clause XXXXX	All levels are shall be recorded on a drawing showing levels at predetermined intervals, and shall be signed by the contractor and the field engineer	Yes	Field engineer	During checking levels	Recorded on the drawing and signed by both parties

EXAMPLE

An example of checklist for steel reinforcement bar before concrete casting for a reinforced concrete structure.

TESTING/INSPECTION ITEM	YES	NO
Working drawing checked and approved		
Latest revision being used		
Bar schedules approved		
Reinforcing steel material approved		
Bar bending and cutting satisfactory		
Corrosion treatment of bars, if required, satisfactory applied		
Bar size and spacing correct		
Bar lap length and location correct		
Bar tied as specified		
Bar assembly rigid and adequately supported		
Cover to bottom bars correct		
Cover to side bars correct		
Cover to top bars correct		
Cover blocks approved including fixing		

It is an industry recommended practice that project specifications require special Tests on Completion and/or testing on completed trial stretches and test samples. This is particularly true for critical high-risk infrastructures such as bridges, water supply schemes or renewable energy projects (wind farms and photovoltaics solar power grids, etc). Special tests on completion and/or testing on trial end products require a considerable amount of resources. This includes specialized equipment and appropriate experts that needs to be planned and captured in the project QAP.

Examples of special test include: pile load tests, tri axial testing on reinforced concrete pipes, testing for trial hot mix wearing course stretch, pump tests for boreholes, etc.



Pile load testing
©PHATR /Shutterstock

Item 4: Process Control Procedures

Adequate process control ensures the soundness of key stages of the construction process to produce a work or component of works that fulfils the desired function. It makes also the overall quality assurance or acceptance process smooth and effective.

The QAP should clearly indicate relevant quality assurance procedures or check points to verify that the Contractor's construction process will not compromise materials and workmanship quality and fitness for purpose of the final product.

There should be established process control procedures for construction materials source approval in terms of material identification and traceability (such as markings), handling, storing, transportation, loading and unloading. Construction materials such as cement, bituminous materials, reinforcement steel bars, etc. need special storage requirements to prevent damage and deteriorations such as corrosion, cement lumps, bitumen aging.

Here is an example that demonstrates good practice process control procedures established by a construction supervision team

KEY MESSAGE

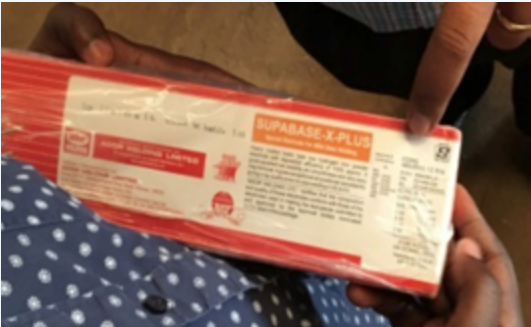
Construction process control is as important as final product quality verification and/or acceptance process as it helps to minimize waste and rework due to non-conformance. It also helps to easily identify the cause of non-conformance allowing for an effective correction measure to be proposed that prevent recurrence.

EXAMPLE

The structural design and project specification stipulated welded splice for steel reinforcement bars on the main reinforced concrete girder of a 50 metre-span bridge. The QA Engineer established the following process control procedures to ascertain that the welding process is controlled and performed by qualified personnel and therefore assure that the welded splice conforms the requirements and fulfils the desired function.

- Verification of welding company and personnel requirements
 - The welding company was required to provide accreditation and welding performance certificate from recognized accreditation organization
 - The welders were required to provide the required qualification, experience and valid welder performance qualification certificates
- Inspection and Testing on welding materials and test specimen
 - Product certification for the welding materials, such as the specified electrodes, are checked
 - Visual process inspection on welding the laboratory test specimen appropriately sampled from site
 - Visual examination and laboratory destructive steel tension tests on the welded test specimen
- Acceptance Inspection and Testing
 - Visual examination and inspection on in situ welding
 - Independent QA inspection , measurement and testing on completed welded splice – depending on the project context and contract requirements dye penetration tests and/or x-ray tests can be performed both in the test and completed welds

ILLUSTRATED EXAMPLES



Product certification checking



Visual welding laboratory inspection



Visual in situ welding inspection



Destructive laboratory testing



Independent QA inspection of welded splice

IDENTIFICATION No.	QTY	DESCRIPTION OF EQUIPMENT	SERIAL	DATE OF NEXT EXAMINATION
PER 2	01	<p>SPlicing WELdMENTS OF PRE-CAST REINFORCEMENT STEEL BARS</p> <p>CONSTRUCTION ON BRIDGE HEADWAYS 21 x 3.3 METRE (S)</p> <p>20MM SPlicing WELDS (DOUBLE PLANE) OF 20MM DIA. REINFORCEMENT STEEL BARS THROUGH PRE-CAST CONCRETE BEAMS OF 23 x 18 METRE (S)</p> <p>20MM SPlicing WELDS (DOUBLE PLANE) OF 18MM DIA. REINFORCEMENT STEEL BARS THROUGH PRE-CAST CONCRETE BEAMS OF 23 x 18 METRE (S)</p> <p>SCOPE OF INSPECTION:</p> <p>THOROUGH VISUAL EXAMINATION AND MPI TEST CARRIED OUT ON EACH WELDS FOUND TO BE SATISFACTORY.</p> <p>AS BELOW:</p>	N/A	N/A

Inspection requirements

Locally produced construction materials from borrow pits or quarry sites need appropriate source approval procedures. This is in terms of land permit, possession of sites, relocation action plans, social and environmental requirements, quantity and quality of materials, reinstatement plan, etc.

Item 5: Control of Non-conformance (NC)

The Non-conformance Report (NCR) is key hold point and statement of facts for raising and recording quality issues that are not in line with the requirements in the Contract and/or relevant statutory requirements. This includes issues related to materials and/or workmanship, and HSSE. Deviations or points of improvement that could lead to higher HSSE risks if they are not addressed can be considered and included in the NCR.

Non-conformance issues can be raised by the Contractor and/or the UNOPS construction supervision team. The non-conformance is formally recorded and tracked to monitor that specified corrective actions that are taken. The results of the corrective actions are reported back through an update to the NCR. It is a good site practice that a consolidated register of all NCRs are logged, tracked and updated regularly.

Upon the raising and issue of a NCR, the Contractor and construction supervision team shall ensure that no further work that could interfere with the approved correction of the non-conformance item shall take place until the non-conformance has been resolved.

EXAMPLE

If the routine inspection and testing on a concrete mix from a batching plant indicates non-conformance when checked against pre-determined mix design proportion, the concrete batch production must immediately cease, necessary corrective measures be taken and compliance should be demonstrated through specified re-inspection and testing. The NCR should also clearly indicate the root cause of non-conformance and proposed actions needed to prevent recurrence. The proposed actions may be to the extent of removal of the Contractor's personnel – such as plant operator and/or contractor's QC Engineer - if the non-conformance was caused due to negligent or fraudulent practices.

Depending on the type and gravity of non-conformance, the corrective action may include rejection, rework or conditional acceptance in accordance to pre-determined criteria in the contracts. Appropriate non-conformance corrective measures require sound professional judgment and relevant expert advice from the design team too as it has far reaching implications on time, scope and quality/fitness for purpose.

Non-conformance actions that may be applied include:

Rejection/Scrap: Project technical specifications typically require rejection limits for a 'Lot' be determined based on statistical criteria. Statistical methods and judgement plans prescribed in specifications help to balance risks to the Contractor and the Employer. Decisions made based on statistical principles are not usually disputed. It should be noted that statistical judgments may not be appropriate for all types of quality requirements.

EXAMPLE

Steel reinforcement bar with yield strength less than the specified minimum strength. In such cases, there are exceptional circumstances where the structural element (beams, columns, slabs, etc.) can be re-analysed and designed based on available steel material in the market. Of course, this requires the expertise and recommendation of the responsible and authorized design practitioner.

CONSIDERATION

For UNOPS projects, source of construction materials should not only be checked against technical quality requirements in the project technical specifications but also material source eligibility requirements by partners in the legal agreement. For example, UNOPS cooperative and grant agreements with USAID have specific eligibility rules -**22 CFR 228 - for procurement of Goods and Services.**

Re-work: This is the process by which the non-conformance work or component of work is brought to specified requirements through relevant correction or additional works. Rework is usually accompanied by relevant re-inspection and testing to demonstrate compliance.

EXAMPLE

Damaged masonry wall can be reworked or repaired and accepted.

Acceptance: Non-conformance work or materials can be conditionally accepted as is based on statistical judgements comparing the sample mean result and individual test values for a given lot. This exception should be clearly prescribed in the Contract with possible scenarios and payment reduction factor to compensate the non-conformance. The overarching determination is the fact that the non-conformance does not compromise safety to life and functionality requirements for the works or component of the works.

EXAMPLE

Marginal percentage compaction of asphalt concrete wearing course as compared to specified Marshall Compaction level.

Item 6: Control of inspection, measuring, and testing tools and personnel qualification

Construction QA activities and related decision making depend mainly on the use of the right tools and equipment for the required inspection, testing and measurement. Performance of the tools and equipment in terms of accuracy, tolerance, dimensions and sizes, etc. are crucial to consistently achieve valid results.

The QAP should clearly indicate the standard sizes, dimensions, calibration requirements, operation and maintenance requirements for the tools and equipment to consistently maintain accuracy and fitness for purpose. The construction supervision team is required to routinely check and verify the performance of these tools and equipment.

EXAMPLE

In the course of QA activities, UNOPS QA Engineer noted that the calibration certificate for the surveying equipment being used for setting out the levels for a water supply pipeline has expired by one month. Subsequently, the Employer Representative immediately instructed the Contractor to stop using the equipment until the recalibration is completed as slight misalignment or inaccurate layout due to error on the survey equipment will compromise the performance of the gravity water supply pipeline.

Calibration shall be based on internationally recognised standards. In case no such standard exists, verification shall be based on manufacturing specifications and tolerances.

It is important to note that the material testing laboratory(s) arrangement could be anyone of the following depending on the project context:

- A commercial laboratory serving both the Contractor and construction supervision team
- Separate on site laboratories for each of the Contractor and construction supervision team
- A single Contractor's laboratory utilised by the construction supervision team
- A single Employer's laboratory utilised by the Contractor

- A joint laboratory operated by either the Contractor or the construction supervision team and utilised by both.
- Two different commercial laboratories used independently by the Contractor and construction supervision team

Whatever laboratory arrangement is decided upon it must satisfy these requirements and provide:

- A verifiable record of the works as tested by the Contractor
- Proof of compliance of the works with the specification
- The facility for the Employer's Representative to undertake whatever testing required to the works are compliant with the specification
- Up-to-date calibration certificates for measuring and testing tools and apparatus

If the measurement and testing is being carried out by an authorized third party commercial material testing laboratories, the supplier or sub-contractor should provide the necessary certification or accreditations and also calibration certificates for the tools and equipment being used.

EXAMPLE

Accreditations include: ISO, ASTM, AASHTO or local Quality Standards Authorities.

Typical tools and equipment on infrastructure construction projects include, but are not limited to:

- In-situ and laboratory material testing equipment such as concrete compressive strength machine, slump tests, sieves, California Bearing Ratio (CBR) testing equipment, Atterberg limit equipment, field density equipment such as sand cones and Troxler, thermometers, DCP testing equipment, measuring gauges, weigh balances, ovens, etc.
- Topographic surveying equipment such as GPS, levels, Total Stations, etc.
- Inspection and measurement tools and equipment such as callipers, measuring tapes, Schmidt hammer
- Borehole pump test equipment, piezometer



Measurement and testing equipment

©UNOPS/SSOC

Quality inspection, sampling, measurement and testing should be performed by appropriate technicians with the required qualification and experience. Qualification of personnel is as critical as the accuracy of measurement and testing tools and equipment. Performing quality measurements and testing requires adhering to accurate procedures, proper recording, analysis and reporting.

EXAMPLE

CBR testing requires strict adherence to specified sampling, preparation, and testing methods and utilizing the right tools and apparatus. These include such as rammers, moulds, spacer discs, soaking tanks, dial gauges, surcharge weights, penetration piston, loading equipment etc.

The laboratory technicians or engineers should be competent enough to correctly perform the sampling, testing, recording, computing and reporting valid and reliable test results that can be used for quality acceptance decisions.



Improper CBR Soaking - the water level should always be maintained above the top of specimen.

Item 7: Documents and records control

Infrastructure construction projects generate considerable management and technical information and documentation throughout the construction and handover stages. Documents are captured and maintained in both physical and electronic formats. Examples include:

- Progress reports
- HSSE reports
- Incident reports
- Site daily diaries or log books, site photographs and/or videos, visitors books, minutes of meetings
- Bonds, insurance policies and securities
- Letters, emails, telephone records, Skype, video conferences, presentations, speeches, fact-sheets, newsletters
- Instructions, notices
- Variation orders
- Submittals
- Inspection, measuring and testing records
- Products or manufacturer certificates
- NCRs
- Shop drawings, calculations, design changes
- Work programmes, interim payment certificates
- Commissioning and handover documents
- As built or constructed information such as drawings, surveys, data sheets etc.
- O&M manuals
- Labour, materials, plant and equipment record lists
- Weather records
- Contemporary records

Record, capture and retention is crucial to baseline the requirements, track changes, control versions and for documentary evidence during handover and disputes or claims evaluation.

The construction supervision team should establish and/or adhere to standard document management approach. Standards include documents style, formatting, templates, internal QA process, file naming conventions and numbering, logs and registers of records, communications, document security and backups. The standard document management approach should take into account internal and legal requirements such as UNOPS corporate branding manual related to image guidelines, writing guidelines, illustrations and icons. Where appropriate to do so, it should also take the reporting requirements and visibility strategies specified



QA Re-bar testing – by qualified Technician and Engineer

in the legal agreements of the partner(s) into account. For UNOPS project, it is compulsory that project documents shall be also stored in project document archive online tool in the enterprise resource planning (ERP) tool – oneUNOPS.

Standard contract forms typically set out procedures and requirements for maintaining contemporary records by the Contractor to substantiate rightful contractual entitlements for time and payment and/or compensation.

The project QAP should clearly establish and/or make reference to existing corporate process and procedures of documents management system. This includes use of appropriate templates and forms, receiving and issuing documents, sharing and/or disclosing project documents to external stakeholders such as media, ownership and intellectual property rights, change management, document storage, and recovery. Some project documents may have confidential details that require written approval from the Employer for sharing with third parties such as the media.

EXAMPLE

Pursuant to UNOPS Works Contract the Contractor requires written consent of the Employer to disclose to any third party the terms and conditions of the contract, or any documents or other information furnished directly or indirectly by either party in connection with the Contract or the Works.

The QAP should provide particular emphasis on the document management and control process for documents that prescribe quality requirements or activities affecting quality decisions to ensure that sufficient, correct and up-to-date documents are being maintained and used. This includes construction drawings, specifications, acceptance inspection and testing reports, product certificates.

During construction, implementation changes are not uncommon. It is important that changes are captured, reviewed, approved and released in a controlled change management approach to mitigate risk of errors or document flaws or conflicting information and data. A typical example of this is drawing submission registers and related version control mechanisms.

EXAMPLE

The QA lead in a project established a process that requires construction supervisors have read-only access to the centralized web-based document repository and registers tool. Construction supervisors receive automatic notifications when versions are changed. They also receive up-to-date, approved and signed construction drawings issued by the QA lead for required inspection, measurement and testing activities.

In cases where a large volume of documentation has been generated during project implementation, document recovery is a challenge unless a formal document control and record keeping and maintenance system has been put in place.

PMs have the ultimate responsibility for maintaining relevant project records during the construction stage and the Engagement Closure Manager (in most cases the PM) then transfers the records to archives after the project close out or handover to the client according to prescribed procedures or requirements in the legal agreement. For example, it is a compulsory requirement that as built drawings and related data should be maintained and handed over to the users to facilitate post-construction operation and maintenance activities.

To effectively manage and maintain a record of all site communications, it is essential that a filing system is adopted to suit the particular circumstances and size of the project. If practicable, the filing system should as much as possible reflect that used by the document archive in oneUNOPS.

CONSIDERATION

UNOPS is committed to openness and transparency in its dealings with external partners and recognizes the need to balance openness with the need to respect vital confidentiality obligations. [OI.CG.2018.01](#) and [OI.LG.2018.04](#) provide instructions and guidance on Media Relations and Information Disclosure respectively.

It should be noted that establishing a good filing system or structure is not the end goal. The system or structure is only as good as the information recorded in it. Relevant, agreed and accurate records are key for robust record keeping.

Item 8: Inspection checklists and templates

To facilitate many of the preceding items in the QAP and the work of the construction supervision team, it is essential to use standardised and consistent checklists and forms. Generic templates for some of these are included in **Annex B**

3.4.2 Health & Safety and Social & Environmental Management

The implementation of infrastructure projects inherently involves considerable health and safety hazards and risks that can result in accidents which have the potential to cause personal injury, fatalities, ill-health and property damage. In addition, infrastructure projects with physical sites can have a direct or indirect positive and adverse impact on the social and natural environment. Therefore, effective HSSE management planning, implementation and performance monitoring is required to mitigate HSSE risks, minimize negative impacts and enhance positive impacts emanating from construction works.

Occupational health, safety and welfare for workforce involved in UNOPS activities and facilities; and Social and Environmental considerations are mandated through organization level policy under the EOD on Occupational Health & Safety and Social and Environmental Management ([EOD.ED.2017.03](#)) and related compliance requirements the Executive Office Instruction (EOI) on the Implementation of Three Levels of Requirements for Health & Safety and Social & Environmental Management ([EOI.CSG.2017.01](#)) and the EOI on Reporting and Management of Health & Safety and Social & Environmental Incidents ([EOI.CSG.2017.02](#)). In addition, host countries where UNOPS operate may also have mandatory statutory HSSE requirements or acts and supplementary provisions or guidelines to be adhered to.

Furthermore, UNOPS HSSE stream under the SSC has developed a number of publications on this subject. These include handbooks, guidance materials and templates to support HSSE organizational level operations with particular emphasis to infrastructure projects.

List of HSSE publications from SSC:

- Social and Environmental Management Handbook (forthcoming)
- Health and Safety Management Handbook
- Social and Environmental Management Templates
- Health and Safety Management Templates
- Social and Environmental management Guidelines
- Health and Safety Guidelines
- HSSE site inspection template

MORE INFORMATION

The levels includes in the EOI on the Implementation of Three Levels of Requirements for Health & Safety and Social & Environmental Management ([EOD.ED.2017.03](#)) range from UNOPS minimum and mandatory H&S and S&E requirements (Level 1) to UNOPS intermediary H&S and S&E requirements (Level 2), and external certification requirements (Level 3).

There are various levels of delegated responsibilities and accountabilities for effective HSSE management across all UNOPS facilities and operations. All personnel are required to contribute to positive HSSE planning, implementation and performance in all operations and projects. It is recommended practice to make HSSE observance an integral part of personnel job requirements (ToR) and share the responsibility to perform tasks in a safe and socially and environmentally responsible manner through:

- Observing all occupational health and safety, and social and environmental policies and guidelines
- Following safe work procedures to prevent and address incidents – to the extent of temporary work stoppages
- Wearing and using personal protective equipment (PPE) wherever required
- Participating in regular and consistent HSSE trainings and workshops
- Proactively prevent and report HSSE incidents
- Identify opportunities for positive impacts

3.4.2.1 HSSE Management in Construction Sites

Promoting excellence in HSSE arena is an industry recommended practice and international norms and standards (OHSAS 18001 & ISO 26000, ISO 14001) in construction projects. This requires awareness and consistent safe working culture. There has been notable improvement in the construction industry in this arena, however, there is no room for complacency when it comes to HSSE.

During the construction phase, potential adverse impacts to the social, natural and built-up environment may occur, unless appropriate HSSE risk mitigation measures are implemented and monitored. In most cases, it is a mandatory project requirement to establish effective social and environmental management and occupational health and safety management systems. This must be accompanied by plans that will help to provide a structured and consistent approach for the management of HSSE risks in physical infrastructure construction sites.

One of the key functions of the construction supervision team is to make sure that every effort is being done to prevent occupational health and safety risks and mitigate or reduce adverse impacts to the natural environment and society at construction sites by all parties involved.

The construction of physical infrastructure projects have inherent HSSE aspects which can be, but are not limited to:

- **Solid and liquid waste management and storage:** Waste from site facilities, camps, construction disposals; discharges from workshops or fuelling bays such as oil and fuel spills, stone crusher sites.
- **Prevention or careful handling and use of hazardous substances:** Asbestos, careful use of necessary chemicals such as pesticides and insecticides in public areas, bituminous materials, chemical admixtures.
- **Protection of the natural and built up environment:** Historical, archaeological and cultural sites, forests, fossils, wild animals, water resources, public and private properties, utilities, landscape.
- **Traffic Management:** Provision and use of appropriate traffic safety and direction signs, barriers, flag persons, diversion roads, haul roads.
- **Borrow Pits and construction material sources management:** Land acquisitions, explorations, use of explosives, restorations.
- **Occupational Health and Safety:** Provision and use of appropriate personal protective equipment, fire protection, on site first aid facilities; working at heights; temporary works such as scaffoldings, crane support, false work, formwork, excavation support, and casings; Use of UNDSS approved and reasonably appropriate vehicles to the area of operations.

MORE INFORMATION

ISO 26000 was introduced in 2010 and provides guidance and recommended practices on Social Responsibility with the ultimate goal of contributing to sustainable development. <https://www.iso.org/news/2011/03/Ref1558.html>

CONSIDERATION

Effective HSSE management and compliance require dedicated resources by the Contractor. In this regard, it is a recommended practice to include measurable/billable HSSE item(s) in the construction bill of quantities and specifications that support construction supervision team to enforce HSSE compliance by the Contractor.

- **Pollution:** Noise, air, light, water source contamination and dust
- **Awareness and Prevention of communicable diseases:** HIV/AIDS, Malaria, etc.
- **Security of the site (conflict and post conflict areas):** The security and safety of the site, the contractor's equipment, UNOPS and clients assets, plant, materials and all other property; the occupational health and safety of personnel on the site and the local community is key considerations for infrastructure projects management. Site security in terms of prevention of unauthorized entry to camps, construction sites and material sites are standard UNDSS security – MORSS compliant requirements
- **Conflict with the host community associated with use of construction materials:** Competition with use of local resources with the community such as bore hole water obstruction for the purpose of construction activities and camp services
- **Prevention of child labour and other abusive working conditions violating fundamental workers' rights**
- **Prevention of sexual exploitation and abuse**

It is good practice that the construction supervision team be vigilant on HSSE aspects while carrying out the day-to-day site quality assurance inspections.

CONSIDERATION

[EOI.CSG.2017.01](#) stipulates a mandatory HSSE weekly site inspection and documenting the findings of the inspection using [HSE05](#)

Occupational Health and Safety (H&S)

It is recognized that construction related health and safety hazards and associated risk varies from site to site. The differences depend on the type and nature of construction work, working environment, attitude and awareness, skills and competency of the workforce, equipment, plant and materials being used.

Health and safety hazards and associated risks in construction sites can be reduced or mitigated through effective control measures designed and implemented based on thorough hazard or risk assessment. Key elements of construction related health and safety risk management broadly include:

- **Hazard identification** – the process of identifying sources or situations with the potential to cause harm (death, injury, illness). Hazards at construction sites may include noise, dust, light, chemicals, moving machineries or equipment, hazardous materials, radiation, biological, electricity, extreme weather, working at heights, or falling materials. Key construction related hazards are typically identified at the design development stage. For example: if the design proposes a deep foundation then hazards related to deep excavation can easily be identified at this stage.
- **Risk assessment** – the process of evaluating the risk arising from the hazard (combination of the likelihood of a hazardous event or exposure and the severity of injury or ill health that can be caused by the event of exposure)
- **Control Measures:** once the hazards are identified and related risks are assessed and rated appropriate control measures that commensurate the risk level must be put in place, implemented and monitored. This will help mitigate or reduce the health and safety risks to acceptable level.
As a general rule, if the risk is high, then the hazard must be eliminated and/or work activity prohibited or mitigation measures put in place to reduce the risk. UNOPS HSSE publications, guidelines and policies specify suitable controls for many common construction site health and safety hazards and risks. However, depending on the circumstances at the construction sites, specific control measures need to be developed that effectively address the hazards and related risks.

MORE INFORMATION

Identification and ranking of natural hazards may be done by using the country specific information found on <http://www.thinkhazard.org/>.

- Creating awareness and consistent safe working culture through provision of necessary information, instruction and training for the construction workforce is one of the key risk control measures. This can typically be achieved through compulsory site inductions, emergency test drills, HSSE campaigns, formal HSSE trainings and certifications, HSSE signage etc.
- **Review Control Measures:** the effectiveness of the proposed control measures need to be routinely monitored to ensure the measures are working as planned and/or if there is a need for improvement or adjustment.

At UNOPS projects sites, the Contractor(s) is (are) functionally responsible to carry out the necessary hazard and risk assessment and propose relevant control measures for UNOPS review and approval. They are expected to expand and further elaborate on the draft health and safety plan and risk assessments that were prepared during the planning and design stages. The contractor(s) is (are) allowed to use their own templates and documents, provided that these are approved by the UNOPS PM as being of at least equivalent quality to UNOPS documents. Alternatively, they can use the UNOPS templates.

OHS Controls

In the order of hierarchy of controls, from highest level of protection and reliability to the lowest level, typical occupational health and safety related hazards and risk controls or practices on construction sites include:

Elimination - involves eliminating the hazard and associated risks. This can be achieved by changing the work methodology that introduces hazards or by removing the hazard completely.

EXAMPLE

- In order to remove the risk of fall from heights, we can work on the ground level then use lifting machines and mobile elevating work platforms to lift and place the unit at the desired floor level, this can be using precast elements instead of cast in situ.
- By removing trip hazard, the risk of fall can be eliminated
- By properly disposing of used hazardous chemicals (such as used oil and lubricants) and chemicals from demolishing - risk of injury, illness or fatalities can be eliminated.
- By checking and clearing land mines before accessing to site the risk of personnel fatalities and property damage from mines can be eliminated.

Removing hazards and/or incorporating robust risk control measures are usually easy at the planning and design stage. Depending on severity of the risks associated with specific hazards, design changes at the construction stage may be warranted to eliminate the hazards and related risks.

Substitution: when a higher rated risk is replaced with a lower rated risk.

EXAMPLE

- The replacement of a very loud ventilation unit with a quieter ventilation unit.
- Replacing cutback bitumen with bitumen emulsion for road pavement works. This reduces the risk of burns and respiratory health problems as emulsion

CONSIDERATION

In depth hazard and risk assessment process and rating mechanisms are indicated in UNOPS HSSE templates -[HS05](#)

can be used cold without heating and also the solvent used for bitumen emulsion is water based unlike the gasoline or kerosene base for cutback bitumen

Engineering: the use of engineering techniques to control exposure to the hazard.

EXAMPLE

- A mechanical guard can be put in place to stop an operator from accessing the moving parts of the machinery. Likewise, a mechanism can be put in place so that if the cover of the machine is opened the machine automatically shuts down to prevent worker interaction with live electricity or moving parts
- Approved design scaffoldings, fall protection guards and safety harness can control the risk of fall while working at heights.
- Provision of temporary diversion roads along with safety signs and lighting will help to segregate the construction site from the road users thereby control exposure of road users to hazards related to the mixing of workers and traffic flows

Administrative controls refer to the use of approved work methodologies and/or procedures, training, work arrangements and safe working practices that help to minimize exposure to hazards

EXAMPLE

- In order to reduce excessive exposure to vibration and noise, employees may be rotated every two-hours between loud and quiet work stations.
- Strict adherence to operational, safety and emergency procedures supplemented by use of the required PPE help to minimize the risk of exposure to radiation while using nuclear measurement gauges such as Troxler nuclear moisture-density apparatus

Administrative controls shall also include the use of signage or warnings, induction for new employees and visitors.



Traffic management signages in road construction sites

Use of Personal Protective Equipment (PPE): This includes earplugs, hard hats, steel-toed foot wear, reflective jackets, life jackets for near to water construction and safety belts. The PPE acts as a last line of defence when an employee interacts with a hazard. The PPE is least effective as a defence because it limits exposure to the harmful effects of a hazard only if workers wear and use PPE correctly.

EXAMPLE

- Safe working practices in terms of the required, regulated and enforced use of PPE on construction sites reduce and can prevent the risk of injuries and fatalities should accidents happen
- In order to prevent skin cancer and/or permanent burns from ultra-violet rays, countries enforce occupational health and safety regulations and codes of practices to force outdoor construction workers to regularly wear protective clothing, or clothing that provides adequate cover to the face and skin.
- Handling and working with toxic substances requires highly specialized undertakings including use of disposable clothing, breathing masks and boots.
- Enforced use of PPE through site access control and restrictions if and when PPEs are not used enhance also safe working culture.
- Site access control and restrictions, if and when PPEs are not used, enhance also safe working culture.

In addition to hazards and risks directly related to construction activities, it is common that physical infrastructure construction activities will result in indirect health and safety hazards both during the construction and usage of infrastructure assets. A typical example is construction wastes or spillages and unmanaged material sites such as borrow pits.

EXAMPLE

Borrow pits can pose long term risks to humans, livestock and wildlife alike both during and after creation and use. Risks include landslides, drowning, vector-borne diseases, and attraction of dangerous wildlife. Formal measures must be taken to ensure that unused borrow pits are reinstated and/or fenced off with access control. It is also possible that the disused borrow pit may become a valuable local source of water.

Health and Safety Management Plan

Infrastructure construction projects require a comprehensive occupational health and safety management plan in order to comply with project specific and general health and safety statutory requirements. The plan should support a structured approach to the management and control of construction related health and safety hazards and risks. This is one of the guiding documents for competent and professional construction supervision activities. The construction stage health and safety plan is developed based on information available at the time during the planning, design development and tender stages.

The health and safety plan should include, but is not limited to:

- Health and safety compliance requirements and standards
- Health and safety related governance structures, roles and responsibilities
- Arrangements for controlling significant site risks
- Health and safety record keeping and communication plans
- Health and safety arrangements at site
- Health and safety audits and review plans
- Emergency and evacuation plans and procedures
- Accidents and incidents investigation and reporting procedures

The health and safety management plan should incorporate necessary health and safety arrangements and procedures for activities during the defects notification period and operations and maintenance.

CONSIDERATION

UNOPS has developed standard project health and safety management plan [HS01](#) that set the minimum key contents including roles and responsibilities of the QA team

EXAMPLE

A typical example for consideration of H&S post construction O&M activities can be through the development and handover of an O&M manual to the end users, which explains the best procedures to operate and maintain the infra-structure asset and/or system in a safe manner and also explains the life safety systems and measures which were included in the project.

In order to develop comprehensive and fit for purpose construction health and safety plans, the Contractor should:

- Gather as much health and safety information about the project, proposed sites of construction, and the surroundings, proposed construction materials, equipment and plant to be used. The contract documents, local statutory requirements, main and specialist contractors and consultants working in the area, HSSE lobby groups, and local communities can be sources of information.
- Examine the sites if there are unusual features that can affect the construction work and vice versa such as:
 - Existing utilities including underground service ducts and overhead power lines
 - Hazardous substances
 - Public settlements and right of way issues
 - Ground conditions
 - Nearby public facilities including schools, health centres, and roads.
 - Other ongoing activities in or near to the sites.
- Examine the site logistics including access, site boundaries, welfare facilities, storage areas, waste handling and disposal areas, and site lighting.

While the Project Manager holds the overall responsibility for Health and Safety management, the construction supervision team provide the necessary technical support in the day to day assurance activities such as

- Carry out hazardous materials assessment for materials within the design, and where appropriate inform key stakeholders/work package contractors.
- Ensure regular liaison between parties on site on health and safety matters
- Ensure consultation with the workforce & visitors
- Check that design changes that affect H&S are recognised and assessed during construction phase
- Ensure that contractor(s) employ effective H&S management techniques
- Ensure effective arrangements in place for site security/access
- Ensure arrangements in place for Site induction and safety briefings
- Ensure that suitable welfare facilities and first aid arrangements are in place
- Ensure that reporting of accidents / incidents structural failures are reported in line with their relevant OI
- Ensure work permit system is established and implemented
- Ensure that risk assessments and method statements are compiled and implemented in timely manner
- Ensure that Fire and evacuation procedures are established and tested

Social and Environmental Management

Depending on the nature and complexity of the particular infrastructure project, an environmental and social impact assessment (ESIA) and related management plans may be required to be developed and approved before the commencement of the infrastructure project implementation. Social and environmental management is often a key compliance requirement of funding sources and governments, in order to ascertain the long term sustainability of physical infrastructure projects.

The social and environment impacts are usually identified as part of the ESIA at the feasibility study and/or design development phases and is included in the tender documents for construction.

One of the key project baseline documents for the construction supervision team is the *Social and Environmental Management Plan* (SEMP). The SEMP includes, but is not limited to, key project activities and the following related aspects:

- Potential positive and adverse impacts to the social and natural environment
- Proposed mitigation and/or enhancement measures to prevent, minimize, mitigate or compensate adverse impacts or to enhance beneficial impacts
- Monitoring tools and indicators to report on performance and compliance against requirements
- Roles and responsibilities for mitigations or enhancement measures and audit and monitoring
- Time and cost

The SEMP is the guiding document for the construction supervision team to carry out relevant monitoring, evaluation and inspection of contractors' activities. It is used to achieve the requirements for the management of social and environmental impacts and mitigation measures in line with specified standards and compliance requirements.

Typical infrastructure construction related social and environmental impacts, both adverse and beneficial, that the SEMP should address can be categorized as:

- **Potential site establishment impacts:** Solid and liquid waste disposals from camp sites, workshops, site logistics; Dispossession of lands and loss of livelihoods; Obstruction of access to water sources and/or impact upon availability of water.
- **Potential construction impacts:** adverse impacts such as dispossession of lands and loss of livelihoods; Obstruction of public access and right of way; Pollution such as dust, noise, light, water; Impacts on fauna and flora such as cutting trees, flooding in case of dams; Degradation of land and/or erosion due to quarry and borrow pits; beneficial impacts such as Employment opportunities.
- **Potential operational/usage impacts:** Improved access to social and economic infrastructures; Improved living conditions; Increased number and frequency of traffic accidents in the case of roads improvements in rural areas.

In addition to specific project requirements, the SEMP should take in to account also applicable local social and environmental acts and requirements. These include social and environmental safeguards policies and systems as well as UNOPS set of policies and guidelines. The compulsory social and environmental information and requirements are normally captured in the tender documents through the ESIA so that the construction contractors can determine the level of time and resource required to implement the proposed social and environmental management and monitoring plans.

The Employer's Representative should support and ensure that gender considerations are adequately addressed in the construction activities and operations. Example of good practice include:

- Ensuring that gender and sexual harassment policies are in place on site to



Used oil discharge from project camps

AND

Dust pollution from stone crusher

©Million Ali Abate

- include sub-contractor staff and that these policies are strictly enforced
- Skills building and training are considered that targets both women and men and facilitates upward job mobility
- Labour force integrated by different ethnic groups or nationalities, in the case of binational projects such as border crossing projects or projects in or near refugee camps
- Construction site practices, flexible working hours, and sanitary accommodation that is female-friendly
- Family-friendly and safe work practices. For example a site that provides safe offsite childcare solutions easily accessible to breastfeeding mothers and parents

3.4.3 Works Contracts Management

Construction supervision is carried out in strict accordance with the standards and quality of works stipulated in the Works Contract. The first task for the construction supervision team is to review and understand the requirements in the Contract. The team must be completely familiar with all aspects of the contract. Such as: requirements for bonds and insurance, measurement and payment, HSSE, reporting, value engineering, variations, inspection and testing standards and codes, and testing frequencies. The person named in the contract as the Employer Representative, usually a UNOPS PM, has the overall responsibility for the day-to-day management of the Works Contract. They are entrusted with certain authority that has been defined and delegated by the Employer.

Works Contract Management is carried out as per the terms and conditions of various mutually supporting and reinforcing documents collectively called 'the contract'. The documents forming the works contract are legally binding documents between UNOPS and the contractor(s). The works contract typically includes the following documents:

- The Articles of Agreement
- The Letter of Acceptance
- The Letter of Tender
- The Particular Conditions
- The General Conditions
- The Schedules (includes schedule of details, schedule of forms securities, the bill of quantities, contractor's key personnel, and plant and equipment requirements)
- The Specifications
- The Drawings

EXAMPLE

Works include:

Activities such as site preparation, excavation, erection, building, installation of equipment or materials, decoration and finishing, and

Services incidental to construction such as exploratory drilling, mapping, satellite photography, seismic investigations and similar services.

As explained at **section 2.3.1** UNOPS has developed a suite of General Conditions of Contract (GCC) based on standards from International Federation of Consulting Engineers (FIDIC). Key elements to take into account when selecting the appropriate GCC include the technical complexity and value of the works, the level of sophistication and technical capacity of the UNOPS team responsible for the project and that of the targeted contractors or consultants. As well as their capacity to assess and manage the risks allocated in the contract and to implement the works in accordance with the contract.

DEFINITION

In line with [UNOPS Procurement Manual](#),

'Contract Management'

refers to all actions and activities undertaken after the award of a contract through a procurement process. It includes administrative aspects of the contract, such as contract amendment, contract closure, record retention, and maintenance of the contract file, analysing and determinations of claims, receiving and issuing notices, monitoring performance, expenditure and reporting, and handling of security instruments.

'Works' refers to all activities and services relating to the design, construction, reconstruction, demolition, repair or renovation of infrastructure, including technical consultancy services relating to works and the supply and installation of technologies such as solar power systems, elevators, etc.

CONSIDERATION

In view of the relative complexity and single point of responsibility placed on the Contractor for both design and construction, the selection of the design and build contract requires formal due diligence studies and consultation with IPMG before the decision is reached to use this form of contract.

A key aspect of Works Contract management and administration by the construction supervision team is understanding and adhering to roles, responsibilities and liabilities. It is also important to understand the extent of their defined delegated authority when carrying out their duties.

EXAMPLE

The Employer's Representative (PM) shall have no authority to amend the terms of the contract and/or relieve the contractor of any duties, obligations or responsibilities under the contract without written authorisation and approval from the Employer.

3.4.3.1 Duties of the Employer's Representative

The construction supervision and contracts administration functions are pivotal role for the Employer's Representative and their team. The Employer's Representative owes a duty of care not only to the Employer but also to:

- The contractor
- Third parties such as the community and others who are affected by the construction activities
- Public in general
- Team members

The Employer's Representative major areas of duties and delegated authorities in relation to the administration of the Works Contracts are explicitly indicated in the applicable Works Contracts.

3.4.3.2 Cooperation and Coordination

As far as possible the Employer's Representative and the Contractor should maintain a cooperative rather than a confrontational relationship. This is particularly important in highly technical work where both parties must work together.

In addition, effective procedures for coordination between the construction supervision team and the Contractor must be established at the commencement of the contract. This is best done at a regular formal progress meetings and/or 'ad-hoc' technical meetings.

EXAMPLE

Site Meetings

As part of the day-to-day works contract management, the Employer's Representative shall hold regular site meetings with the Contractor(s) to discuss overall progress or items of a more specific nature (e.g. a delay in progress, a technical problem or quality issues). Agreed action points should be recorded in the minutes as a true and correct reflection of the deliberations, signed by all parties and communicated preferably through a formal covering letter by the Employer's Representative. Such minutes of meetings can be one of the key reference documents in case of contractual disagreements and/or claims.

MORE INFORMATION

Robust contract management is instrumental to mitigate organizational risks and liabilities associated with non-performance and breaches of contract. The OI on UNOPS works contracts ([OI. IMPG.2018.07](#)) and upcoming guidelines on UNOPS Works Contract Management provide mandatory instructions and detailed recommended practices and procedures for effective and risk based contracts management.

3.4.4 Project Controls

Project controls are the data gathering, management and analytical processes used to predict, understand and constructively influence the time and cost outcomes of a project. It is achieved through the communication of information in formats that assist effective governance and management decision making.

Cost and time are among the key performance targets and variables of infrastructure projects during implementation. Almost invariably, time is the most critical of these resources on any infrastructure project, as there may be serious financial implications if there are delays in the works. Any change to the time aspects of an activity may affect the cost. Any change to the cost or scope of an activity will almost invariably affect the timing. Time and cost are interdependent.

Construction projects are expected to be completed within agreed cost and time constraints. However, cost and time over-runs are rather common in infrastructure construction projects due to various reasons. These include:

- Unforeseen physical conditions
- Extreme weather conditions
- 'Force majeure' events
- Late possession of site,
- Delayed permits
- Delayed drawings and/or instructions
- Contractual disputes and claims
- Design flaws
- Inadequate project controls

The construction supervision team has a key function to consistently monitor and control progress against plans for both physical and financial progress to make sure that the project remains on track within the stipulated contingency of time and cost. If there are unavoidable changes or deviations that will significantly impact progress and/or cost, the project control procedures should initiate a timely variation and change management process in accordance with the Works Contract variation procedures and requirements. Effective project control procedures, systems and practices are designed to ensure delivery within the project requirements of time and cost. They also to provide timely advance indications of any deviations from requirements for the necessary prompt corrective or recovery plans.

UNOPS construction supervision team independent project control functions should not be confused with the Contractor's internal controls. These usually take the more detailed elements of the cost for each bill of quantity items as well as unit rates including profits and daily production efficiency in to account.

The key baseline documents for construction project controls and monitoring of schedule and cost are:

- The contract baseline programme (includes cash flow estimate and key milestones)
- The contractor's priced Bill of Quantities

3.4.4.1 Contracts Programme

In accordance with the UNOPS measured price Works Contract, Contractors are required to submit a fully detailed contract programme to the Employer's Representative no later than 21 days after the date of the Contract. The Employer's Representative (UNOPS PM) has the responsibility to review and determine if the Contractor's contract programme is in line with the Contract requirements and contains the level of details and justifications required to monitor and control the progress of the execution of the works.

CONSIDERATION

"Date of the Contract" means the date of execution of the contract as stated in the Instrument of Agreement.

A fully detailed contract programme typically includes, but is not limited to:

- Time schedule Gantt chart with
 - All key tasks and activities, including major inspection and testing, with start and end date and indication of free slack.
 - All milestones and milestone dates
 - Resource allocation for each task or activity
 - The order of work execution or dependencies
 - Critical path method
 - Project calendar stating working days, holidays and planned suspensions
- Resource mobilization schedule (workforce, materials, equipment and plant)
- Estimated monthly cash flow with cumulative S-curve
- Schedule of interim payments
- Method statement for execution of major items of works
- Mathematical justifications or details showing adequacy of contractor's estimate of resources for each major items of works
- Breakdown of unit rates for major items of works in the Bill of Quantities
- Advance payment disbursement schedule, if applicable.

Once the contract programme has been reviewed and accepted by the Employer's Representative, the Contractor should breakdown the programme in to weekly and daily programmes and submit to the construction supervision team for routine follow ups and monitoring.

A progress review should be part of the regular agenda for the weekly or monthly meetings between the Contractor(s) and construction supervision team. The progress review should include an examination of the actual progress and/or accepted method or precedence of works execution and/or key inspection and testing activities timelines during the review process. If the base contract programme is found to be significantly inconsistent with any of these, the Employer's Representative shall instruct the Contractor to submit a revised programme clearly describing the proposed modifications necessary to expedite progress and ascertain completion of works within the specified time for completion.

EXAMPLE

After noting a two-month delay on import and delivery of steel reinforcement bar for a reinforced concrete foundation footing during the construction of a four-storey school building expansion and subsequent delay on construction of the RC footings, the Employer's Representative determined that completion of the school building will not be possible within the specified time for completion that has to coincide with the beginning of the new school year to accommodate new uptakes. Accordingly, the Employer's Representative instructed the Contractor to submit revised work programme clearly indicating the modifications necessary to achieve substantial completion of the school building within the original time for completion.

Subsequently, the Contractor submitted a revised work programme describing the following key adjustments to the work programme:

- Change the project calendar to work in to two shifts
- Use concrete truck mixer pumps instead of stationary concrete mixers
- Use chemical admixtures to accelerate hydration (setting time) and achieve early development of strength thereby reducing curing time

3.4.4.2 Cash Flow

The cash flow is effectively a financial programme of the works or the financial implications of the works for the Employer. It indicates when and how much the Employer will be paying the Contractor through interim payment certificates and also indicates the financial progress.

The baseline information needed for the cash-flow estimate include the Contractor's priced bill of quantities (unit of measurement, estimated quantities, unit rates and total amount for each bill items and provisional sums), specified method of measurement, mode of payment and minimum and maximum interim payment amount and instalments.

The information indicated in the bill of quantities are normally best estimates based on the design and specifications. Control and accurate measurement of the actual works executed is the key responsibility of the construction supervision team while certifying the Contractor's monthly statements. Actual quantities of works shall be regularly updated and compared with the original quantities to avoid scope creep and cost overrun surprises.

The Employer's Representative may need to implement the option of value engineering, should any major bill items be foreseen to be significantly exceeding the quantities specified in the Contract. This is also the case if there is an imminent risk of cost over-runs due to other reasons such as currency exchange rate loss. Such value engineering cost control to compensate anticipated cost over-runs should not compromise life safety and functionality (fitness for purpose) of the infrastructure asset and should be carried out through a formal and approved change management procedures.

Disruption of the Contractor's works due to various reasons, such as delayed instructions or drawings, changes to inspection and testing plans made by the Employer's Representative, can potentially result in contractual claims by the Contractor for an extension of time and associated costs. The construction supervision team has to be completely familiar with the contract terms and conditions and act within the limit of delegated authorities to mitigate any risk of cost and time implications as a result of inadequate or incompetent construction supervision activities.

EXAMPLE

Inspection and Testing Plan – Change to Testing Frequency

The standard specification for the project requires concrete consistency slump test for every batch of freshly mixed concrete and compressive strength test for every 20m³ of concrete placed per day and for each mix design. The slump test follows the ASTM International Standard Practice for sampling freshly mixed concrete (ASTM C 172).

The UNOPS PM (Employer's Representative) has issued a written instruction to the Contractor to carry out the tests as often as necessary and when requested by the Employer's Representative. The Contractor's Representative accepted the instruction and at the same time indicated its right to claim for time and cost in view of the change to the testing frequency, which was more stringent than specified in the Contract and would require additional effort for QA and QC.

4. Conclusion

Physical infrastructure projects contain a high degree of risk and complexity compared to other projects. They are also susceptible to conditions relating to the environment, social and political shocks. The project will remain vulnerable to these conditions throughout its lifecycle – from implementation, to completion and the usage stage.

However, these effects and risks can be alleviated and/or avoided through effective construction supervision which is also essential to the successful delivery of construction related projects. By following the recommended good practices detailed in the CSG, project team will be able to mitigate and reduce the inherent infrastructure project risks related to construction implementation.

The key construction supervision areas of focus are quality management, health and safety, social and environment management; contracts management; and project controls. Throughout each of these areas it is essential to ensure clear definition of roles, responsibilities and delegated authorities. It is also important to ensure that activities are delivered through the principled approach of effective resourcing, communication and reporting, monitoring and evaluation, maintaining records and, finally, reviewing feedback and lesson learned to improve future guidance.

The successful implementation of effective construction supervision help deliver infrastructure asset to the client that is fit for purpose, satisfies health and safety requirements and prepared against social and environmental issues. This guidance, and hence, helps construction supervision team to gain appropriate knowledge and consistently adhere to recommended good practices.

Annexes

Annex A: Quality Related Roles for Works Implementation Modalities

Implementation Modality	UNOPS Contractual Role/ Function	Description	QM Roles			
			UNOPS	Contractor	Consultant	Partner
Standard Works Contract	UNOPS both as Employer and Employer's Representative	This is where UNOPS enters into a Works Contract with a Contractor to implement the works	General Oversight and Quality Assurance	Direct Quality Control of the works	NA	
	UNOPS as Employer only	This is where UNOPS enters into a Works Contract with a Contractor to implement the works, and also into a Consultant Contract with a third party to act as Employer's Representative and supervise the implementation of the works	General Oversight of the works implementation	Direct Quality Control of the works implementation in accordance with the design provided by the Employer.	Quality Assurance of the works implementation	
	UNOPS as Employer Representative only	This is where Partner/s enters into a Works Contract with a Contractor to implement the works and nominate UNOPS to act as Employer's Representative and supervise the implementation of the works	Quality Assurance of the works implementation	Direct Quality Control of the works implementation in accordance with the design provided by the Employer.	NA	General Oversight of the works Implementation
Direct Implementation	UNOPS as Employer, Employer's Representative and Contractor.	This is where no formal form of contracts are used and the works are implemented by UNOPS in house team	Responsible for the overall Quality Management, General oversight and delivery of the works.	NA	NA	NA
Design and Build Contract	UNOPS as Employer and Employer's Representative	This is where UNOPS enters a DB contract with the prime Contractor in which the Contractor will be responsible for both the design development and implementation of the Works	Responsible for the general oversight and Quality Assurance of the design development and works implementation	Direct Quality Control and delivery of the design and works implementation		
Technical Advisory/ Assistance	UNOPS as Implementation Consultant (IC)	This is where UNOPS acts as an implementation consultant (IC) to partners and provides technical advisory/assistance services while partners are fully responsible for design and construction of the works	Technical Advisory/Assistance	Direct Quality Control of the works implementation in accordance with the design provided by the Employer.	Quality Assurance of the Works Implementation	General Oversight and Quality Assurance
Labour Based Construction Methods		This is where UNOPS deploys the local community for implementation of low risk infrastructure works	Overall Quality Management, oversight and guidance role for implementation of the works by CBOs.	NA	NA	NA

KEY SITE MEETINGS TEMPLATES

- [01 Contract kickoff meeting](#)
- [02 Monthly site progress meeting](#)

INSTRUCTION, INSPECTION AND REQUEST TEMPLATES

- [03 Site instruction](#)
- [04 Issue of clarification/information](#)
- [05 Confirmation of verbal instruction](#)
- [06 Approval for work/materials](#)
- [07 Inspection and testing report](#)
- [08 Permit to work/proceed](#)
- [09 Inspection and testing plan](#)

SITE RECORD AND REPORT TEMPLATES

- [10 Daily log book](#)
- [11 Monthly progress report summary](#)
- [12 Variation order](#)
- [13 Resource record summary for day work](#)
- [14 Drawing/report submission register](#)
- [15 Measurement and testing equipment status report/register](#)
- [16 Submittal review and approval](#)
- [17 Interim payment certificate](#)

CONSTRUCTION NON-CONFORMANCE

- [18 Non-conformance report](#)
- [19 Non-conformance register](#)

TESTING AND COMMISSIONING TEMPLATES

- [20 Construction punch list](#)
- [21 Infrastructure asset handover document](#)

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