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PUB-WOOD

Construction process

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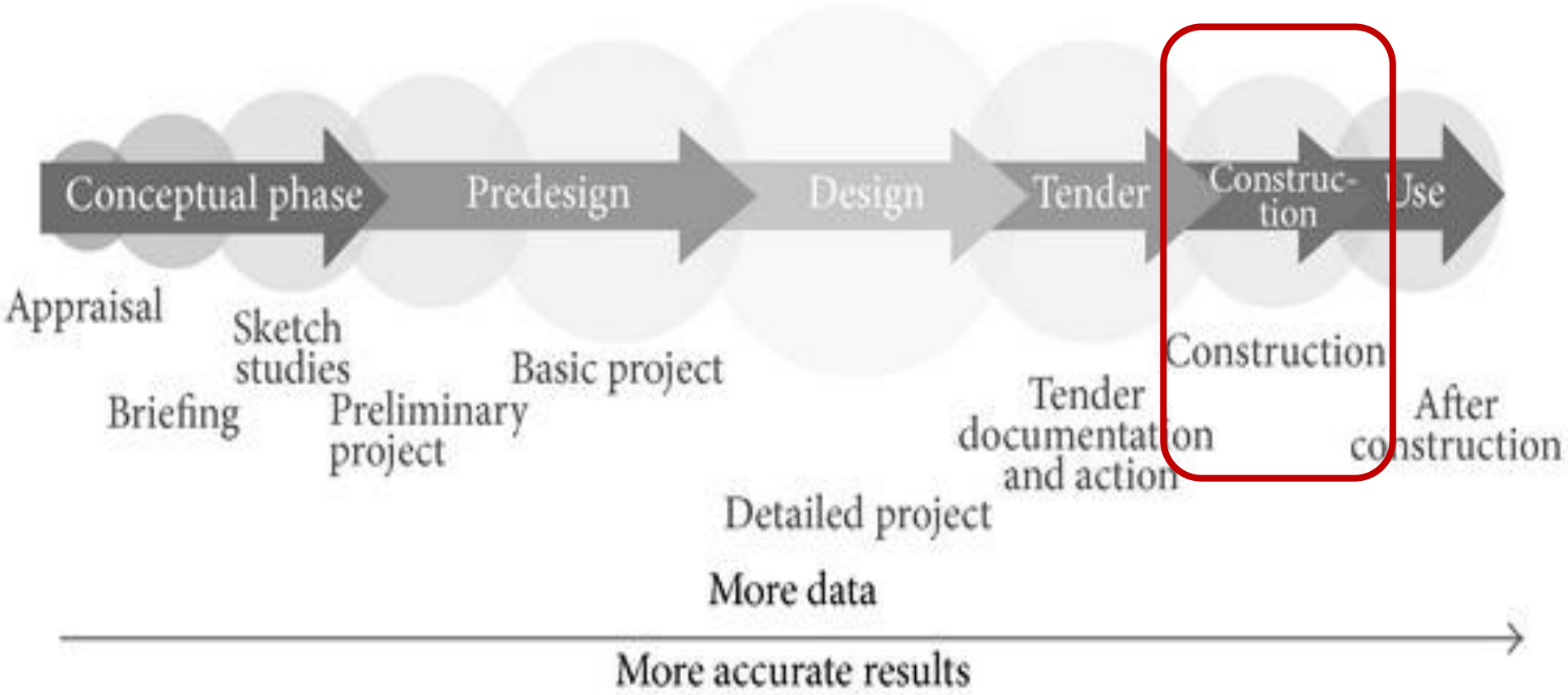
VALSTYBĖS ĮMONĖ REGISTRŲ CENTRAS

STUDY AND CONSULTING CENTER

Content

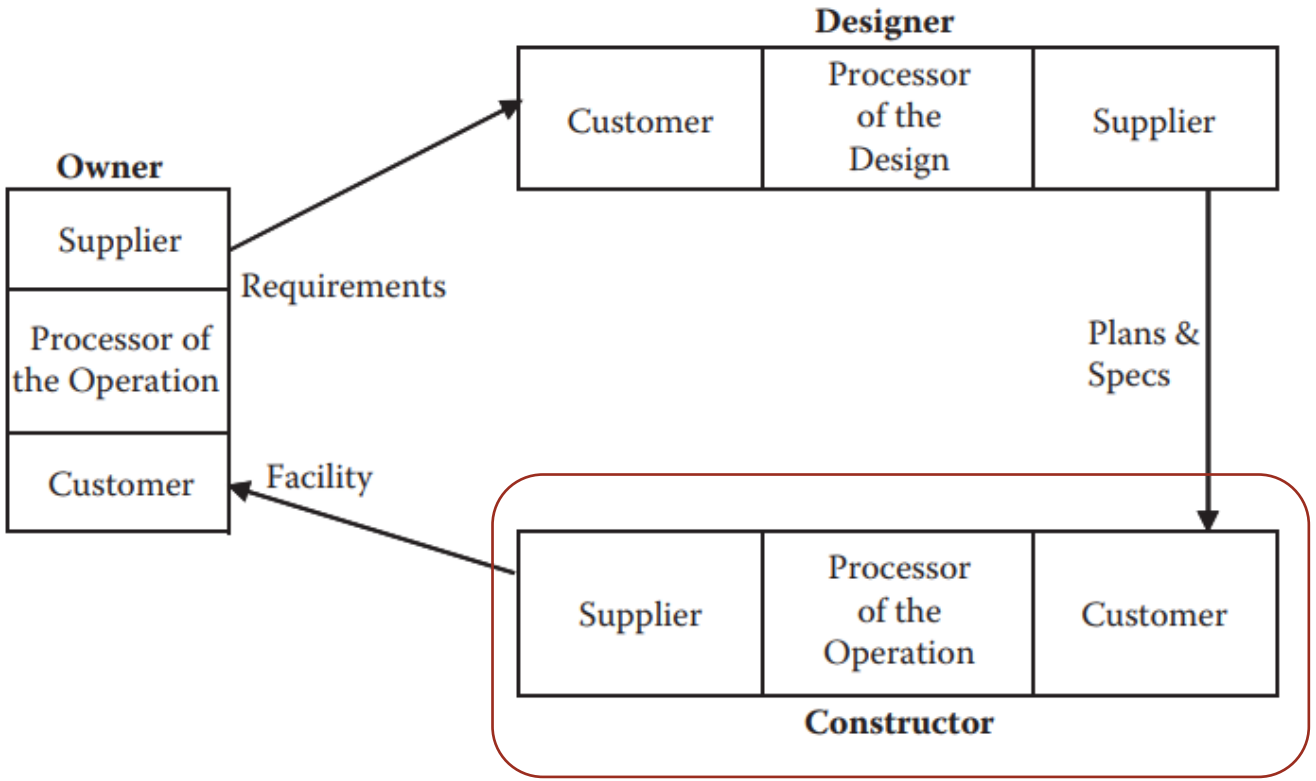
- Activities in construction stage
- Monitoring and control
- Quality control, incl. standards
- Documentation

Main phases



Source: Bragança et al. (2014)

Triple role concept applied to construction



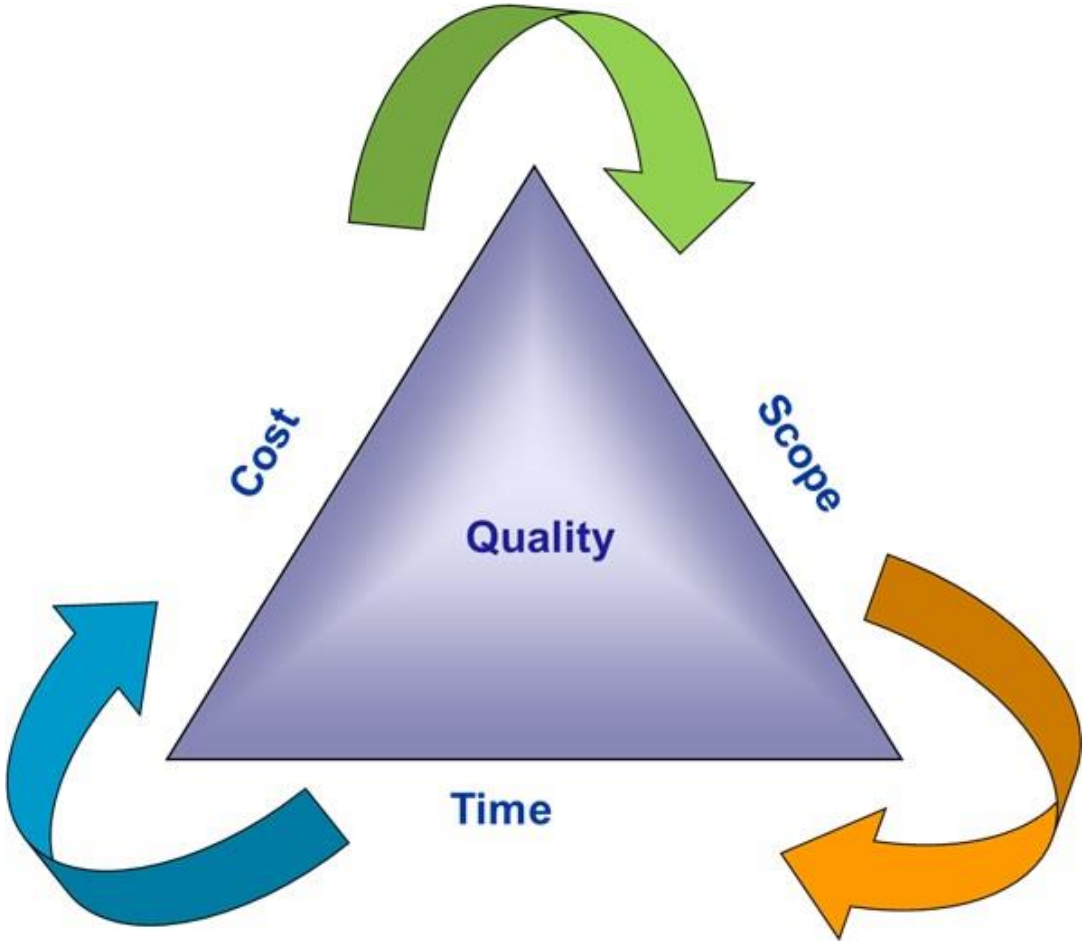
Source: Rumane (2011)

Construction phase

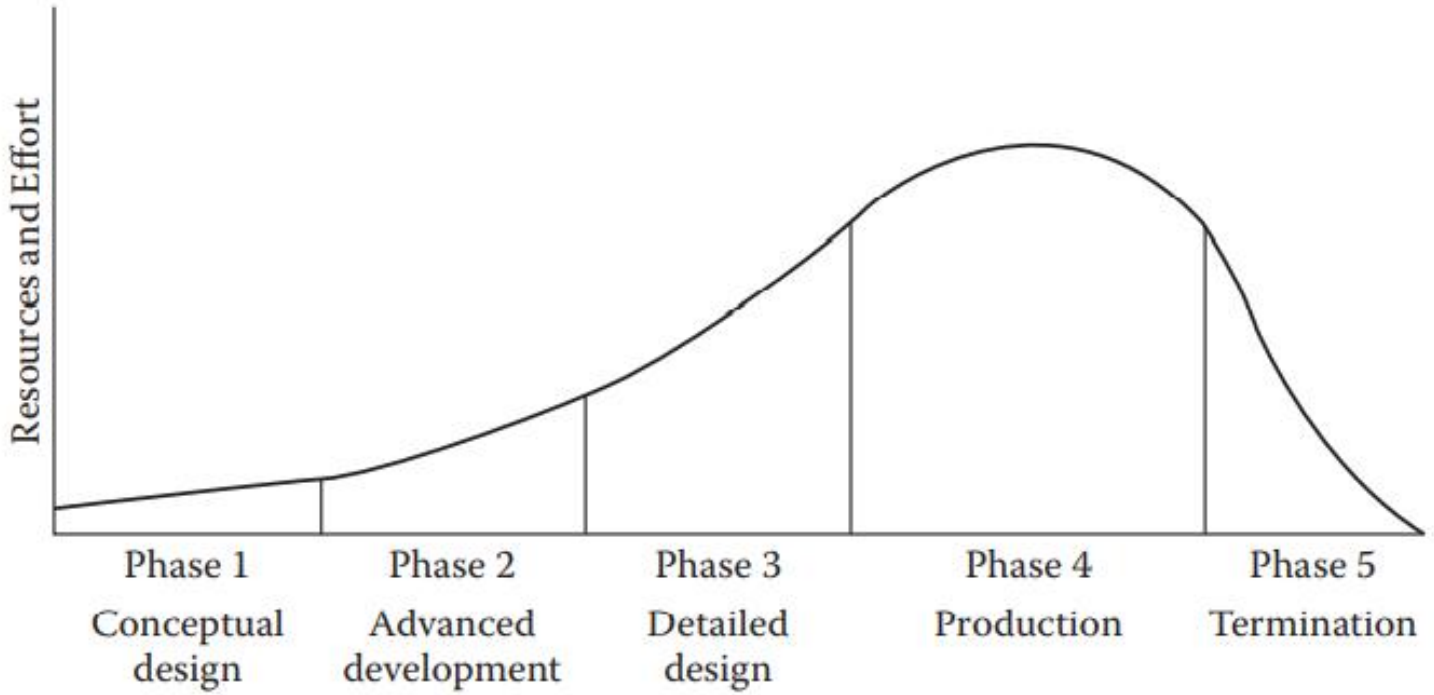
- **Construction** is the translation of the owner's goals and objectives into a facility built by the contractor.

Source: Rumane (2011)

- Construction has to be performed as stipulated in the **contract documents**, **plans, and specifications within budget** and **on schedule**.

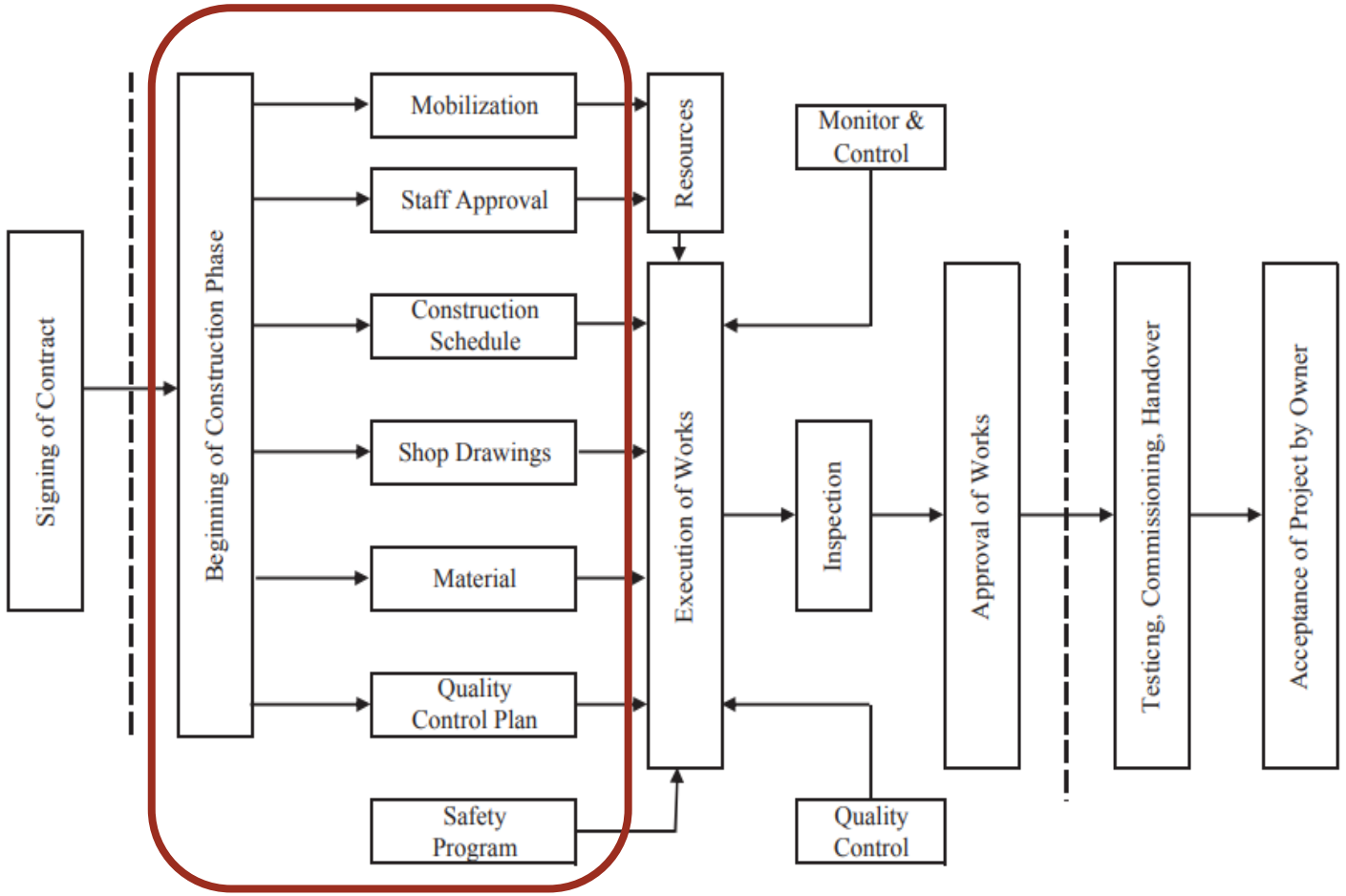


- A majority of total project budget and schedule is used during construction.
- The time required for the construction phase of the project is much higher than the time required for the other phases.



Source: Shtlub et al. (1994)

Major activities during the construction phase



Source: Rumane (2011)

Mobilization

- The contractor is given a few weeks to start the construction work after the signing of the contract.
- During this period, the contractor is required to perform many of the activities before the beginning of actual construction work at the site.
- **Necessary permits** are obtained from the relevant authorities to start the construction work.

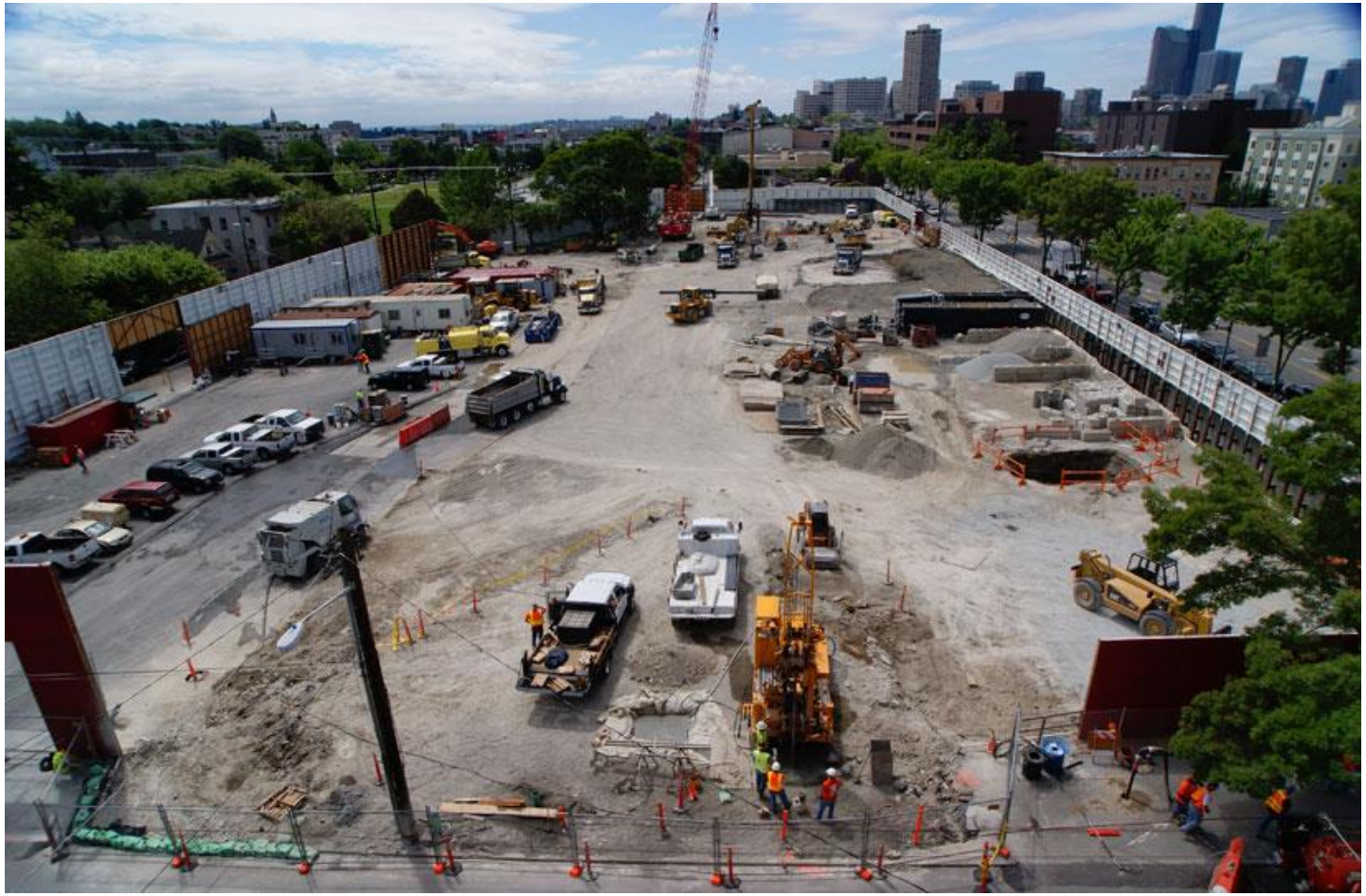
Source: Rumane (2011)

Examples of mobilization activities

- Set up site offices and storage
- Construct temporary access roads, lay down areas and perimeter fences
- Install the necessary utilities for construction
- Set up a temporary firefighting system
- Perform site survey and testing
- Satisfy health and site safety requirements
- Submit preliminary construction program
- Selection of core staff as mentioned in the contract documents
- Insurance policies
- Selection of subcontractor
- **Mobilization of construction equipment and tools**
- **Workforce to execute the project**

Source: Rumane (2011)

Mobilization of Seattle's U-Link extension



https://www.tunneltalk.com/Seattle-U-Link-Jul10-Construction-mobilisation.php

Resources/Procurement

- Once the contract is awarded, the contractor prepares a detailed plan for **all the resources** needed to complete the project.
- The contractor also prepares a **procurement log** based on the project completion schedule.

Source: Rumane (2011)

Staff

- Workmanship is one of the most important factors to achieve quality in construction.
- It is required that the **construction workforce be fully trained** and have **full knowledge** of all the related activities to be performed during the construction process.

Source: Rumane (2011)

Minimum core staff needed during the construction period

- Project manager
- Site senior engineer for civil works
- Site senior engineer for architectural works
- Site senior engineer for electrical works
- Site senior engineer for mechanical works
- Site senior engineer for HVAC works
- Site senior engineer for infrastructure works
- Planning engineer
- Senior quantity surveyor/contract administrator
- Civil works foreman
- Architectural works foreman
- Electrical works foreman
- Mechanical works foreman
- HVAC works foreman
- Laboratory technician
- Quality control engineer
- Safety officer

Source: Rumane (2011)

Request for staff approval

Project Name
Consultant Name

REQUEST FOR SITE STAFF APPROVAL

CONTRACT NO. :
CONTRACTOR :
NO. :
DATE:

SAMPLE FORM

To : Owner

1. Name :
2. Profession :
3. Position No. in Document-I :
4. No. of years of Experience :
5. Membership of Professional Body : Valid ☐ Not Valid ☐
6. Requested Date of Commencement :
7. Remarks :

Signature Contractor's Project Manager

OWNER COMMENTS APPROVED ☐ NOT APPROVED ☐

Owner Rep. Signature Date

Distribution OWNER A/E CONTRACTOR

Source: Rumane (2011)

Request for subcontractor approval

Project Name

Contract No.:
Contractor :

CONTRACTOR REQUEST
FOR SUB-CONTRACTOR APPROVAL

Serial No.: .....

Kindly approve the following as a SUB-CONTRACTOR in the above mentioned Project

Sub-Contract Works _____
Sub-Contractor _____
Address (Head Office) _____
_____
Reference Letter _____

SAMPLE FORM

Attachments:

Commercial Register ☐	Foundation Contract ☐
Experience	Resources
Current Work	Financial Status
Others (List, if any)	

.....
.....
.....

Performance Bond (Yes/No) _____ No. _____

Signed by
Contractor's Representative _____ Date: .....

OWNER'S NAME

Received by: _____ Signature : _____ Date: .....

SITE SUPERVISION CONSULTANT

Received by: _____ Signature : _____ Date: .....

Consultant's recommendation : _____
.....
.....
.....
.....
.....

Signed by
Resident Engineer _____ Date: .....

Distribution : OWNER(Original) Supervision Consultant (Copy) Contractor (Copy)

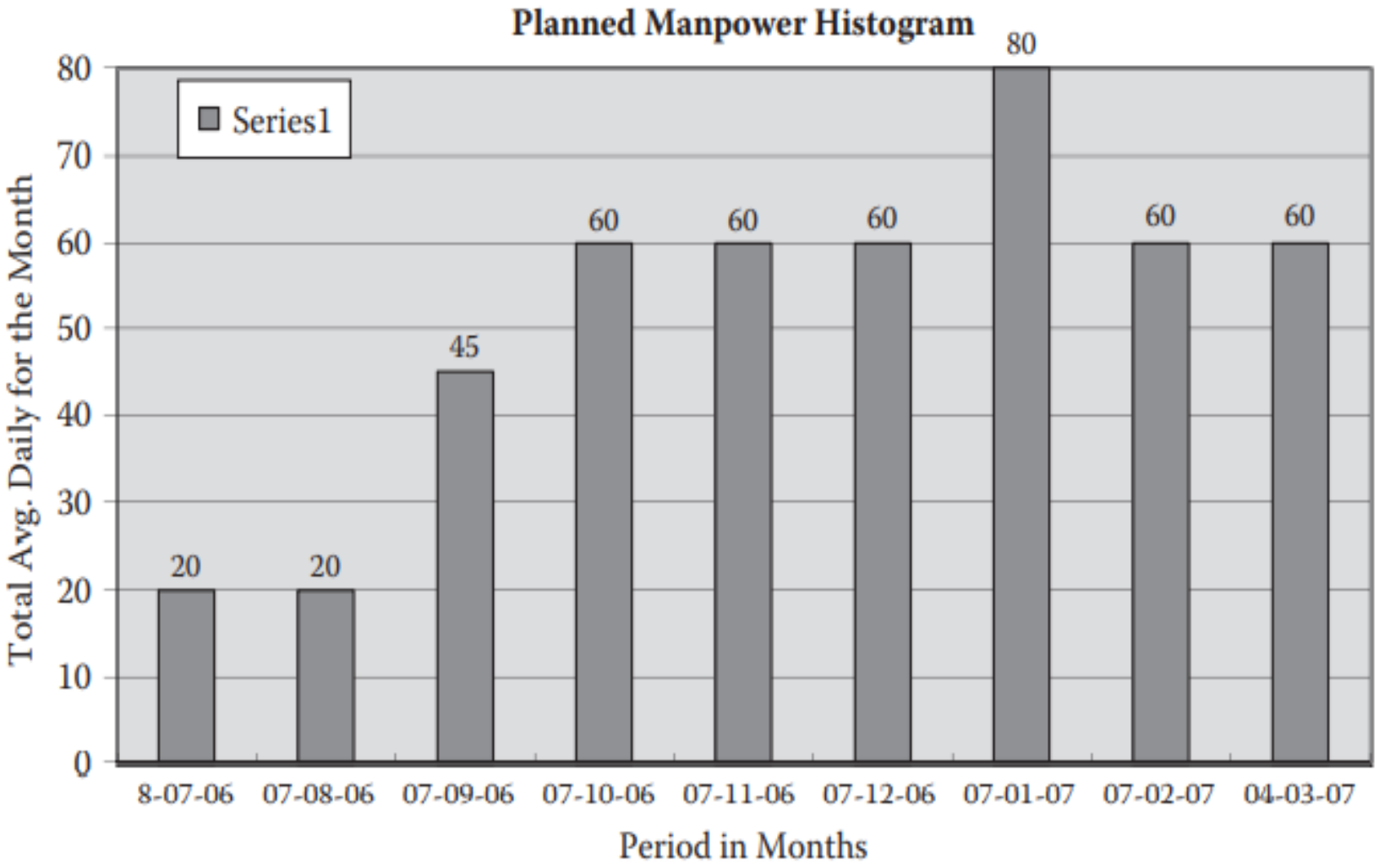
Note : Contractor shall submit Original to OWNER with copy to Site Supervision Consultant.

Source: Rumane (2011)

The main contractor has to manage all the staff by:

- Assigning daily activities
- Observing their performance and work output
- Daily attendance
- Safety during the construction process

Source: Rumane (2011)



Source: Rumane (2011)

Equipment

- The contract documents specify that a **minimum equipment** set is to be available on site during the construction process to ensure smooth operation of all the construction activities.

Source: Rumane (2011)

Examples of equipment

- Tower crane
- Mobile crane
- Normal mixture
- Concrete mixing plant
- Dump trucks
- Compressor
- Vibrators
- Water pumps
- Compactors
- Concrete pumps
- Trucks
- Concrete trucks
- Diesel generator set

Source: Rumane (2011)

Equipment schedule

Project Name
Consultant Name

Contactor Name:
Contract No.

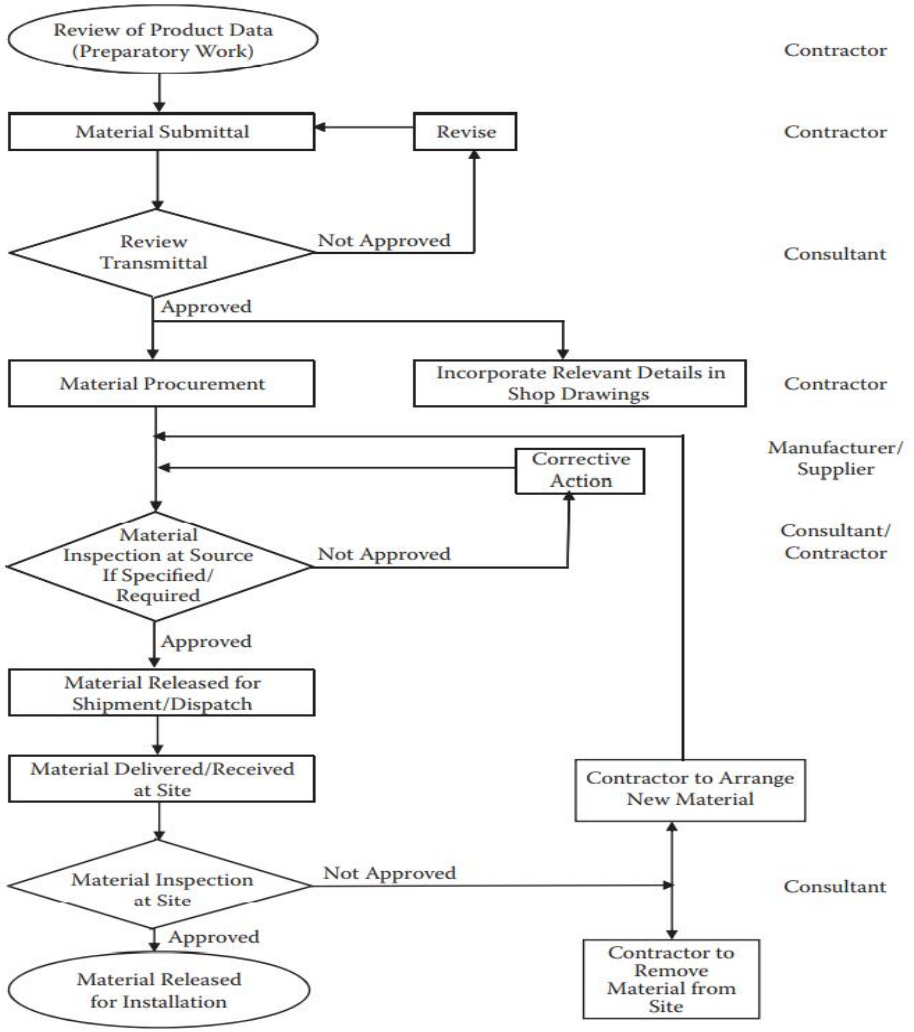
CONTRACTOR'S EQUIPMENT SCHEDULE

Sr.No.	Equipment	Qty.	Dec-03	Jan-04	Feb-04	Mar-04	Apr-04	May-04	Jun-04	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04	Jan-05	Feb-05	Mar-05	Apr-05	May-05	Jun-05	Jul-05	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06	Feb-06	Mar-06	Apr-06	May-06
1	Tower Crane	2																													
2	Mobile Crane 30 Ton	1																													
3	Loader	1																													
4	Bulldozer	2																													
5	Tipper Trucks	10																													
6	Construction Lift	2																													
7	Plate Compactor	2																													
8	Small Vibrator Roller	2																													
9	Bar Bending Machine	2																													
10	Bar Cutting Machine	2																													
11	Concrete Pump	1																													
12	Air Compressor	3																													
13	Diesel Generator	1																													
14	Water Pumps	2																													
15	Water Tanker	1																													

EXAMPLE SCHEDULE

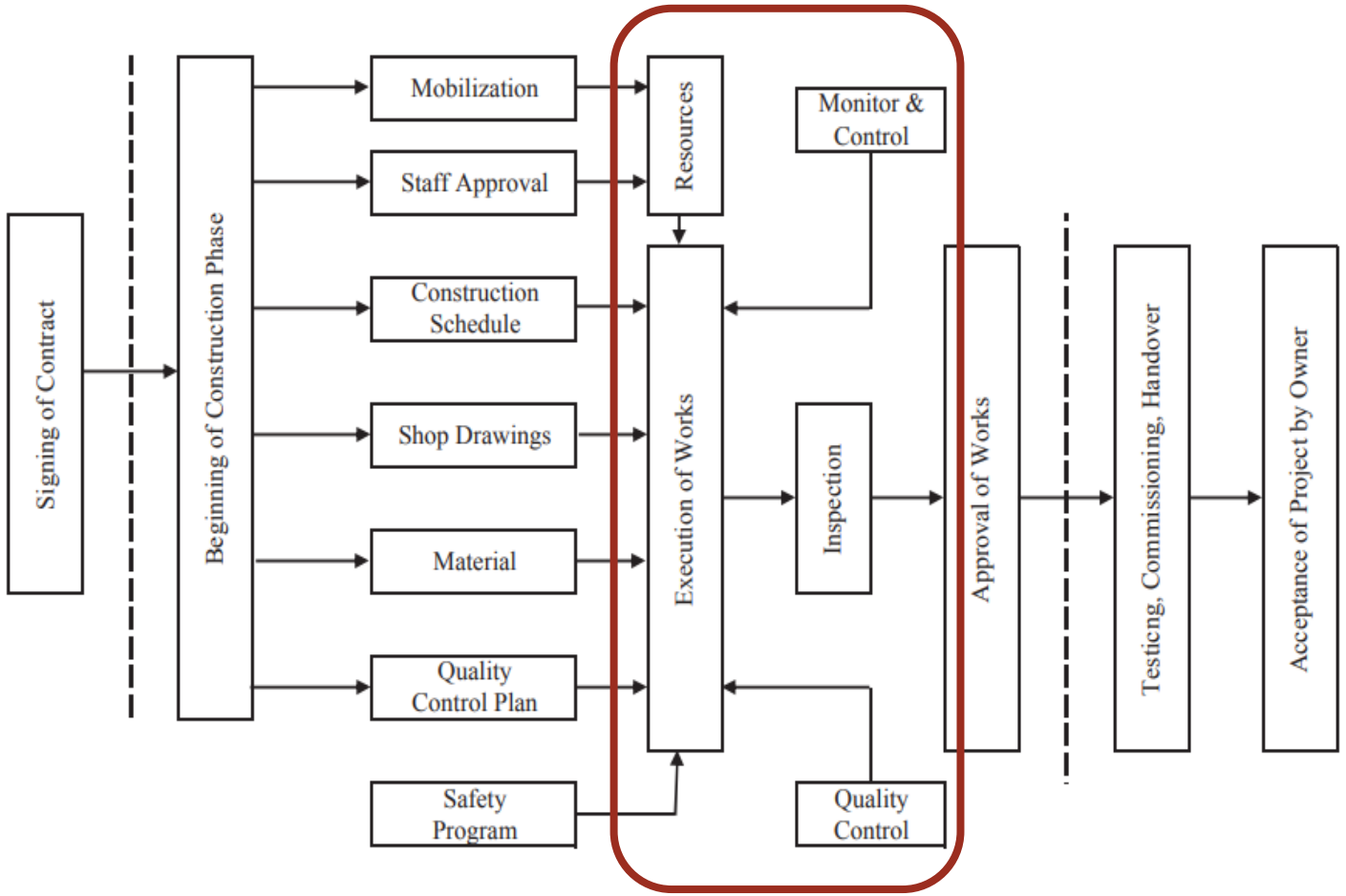
Source: Rumane (2011)

Material approval and procurement procedure

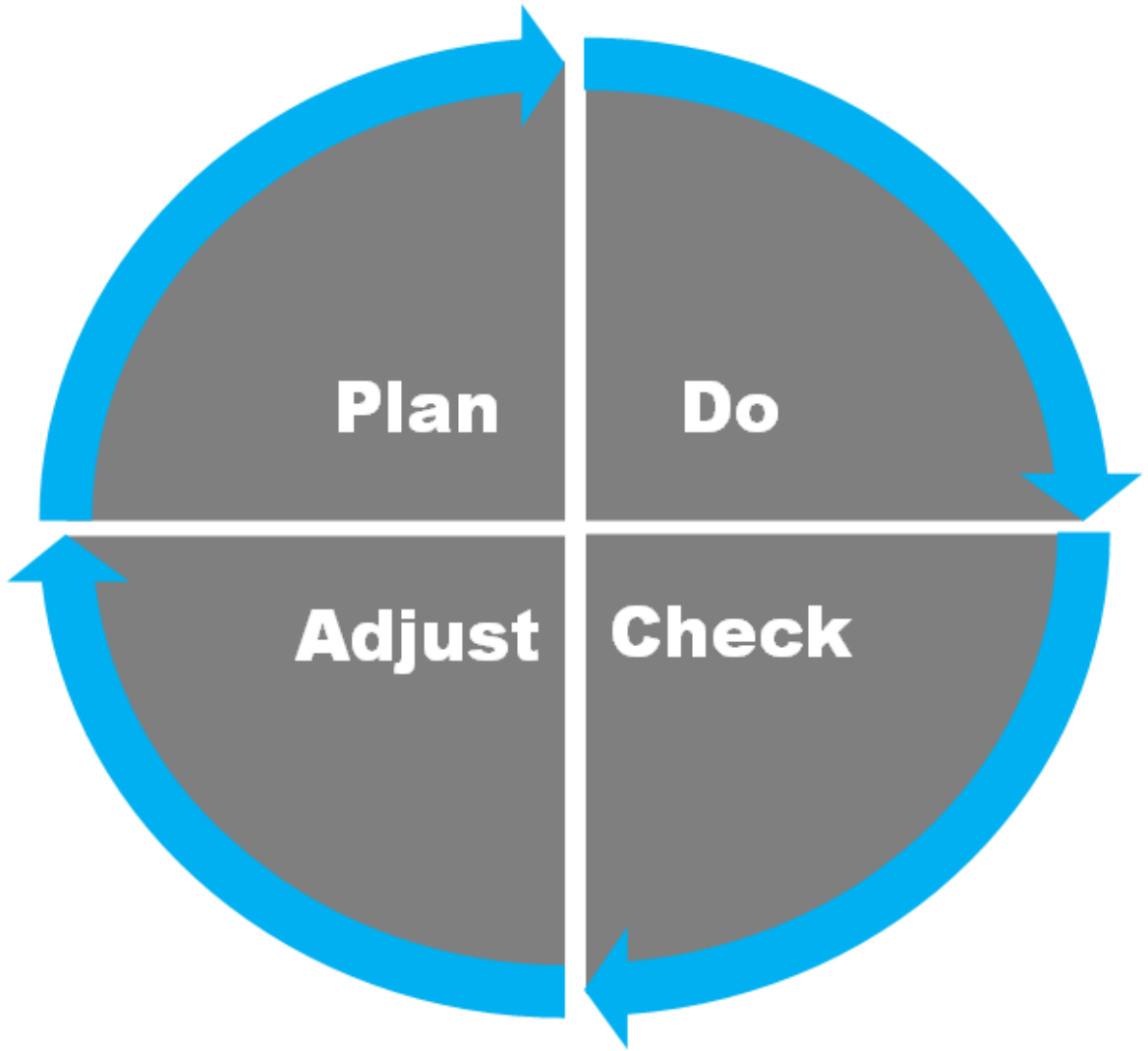


Source: Rumane (2011)

Major activities during the construction phase



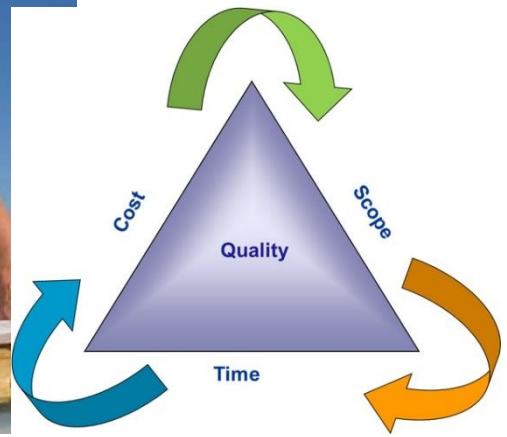
Source: Rumane (2011)



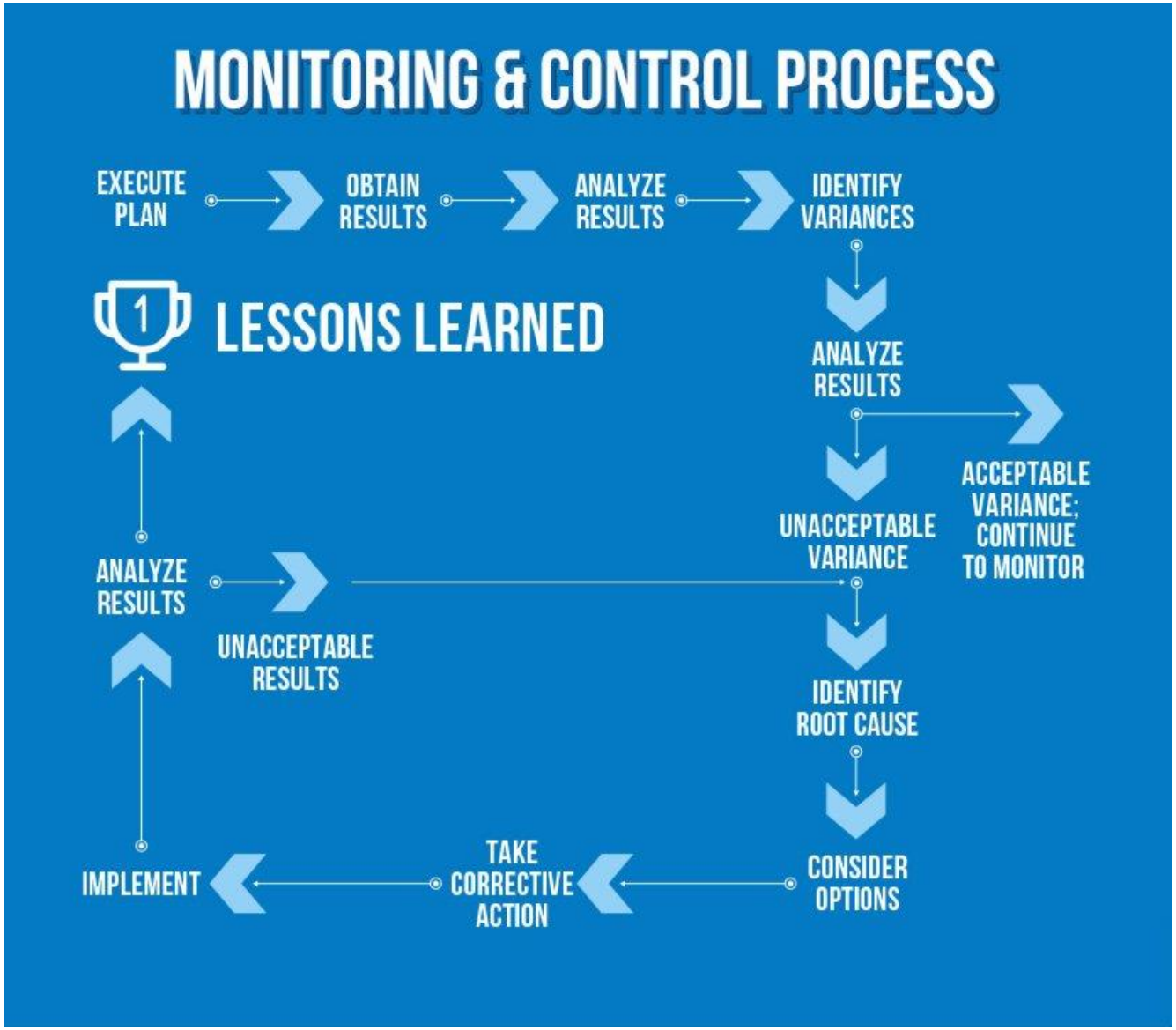
Source: https://leanconstructionblog.com/First-Run-Video-Studies-Plan-Do-Check-Adjust.html

Monitoring and Control

- Progress on the project must be monitored on an **ongoing basis**.
- Its aim is to recognize any obstacles encountered during execution and to apply measures to mitigate these difficulties.
- There are mainly three areas where project control is required: (1) **budget**, (2) **schedule**, and (3) **quality**.

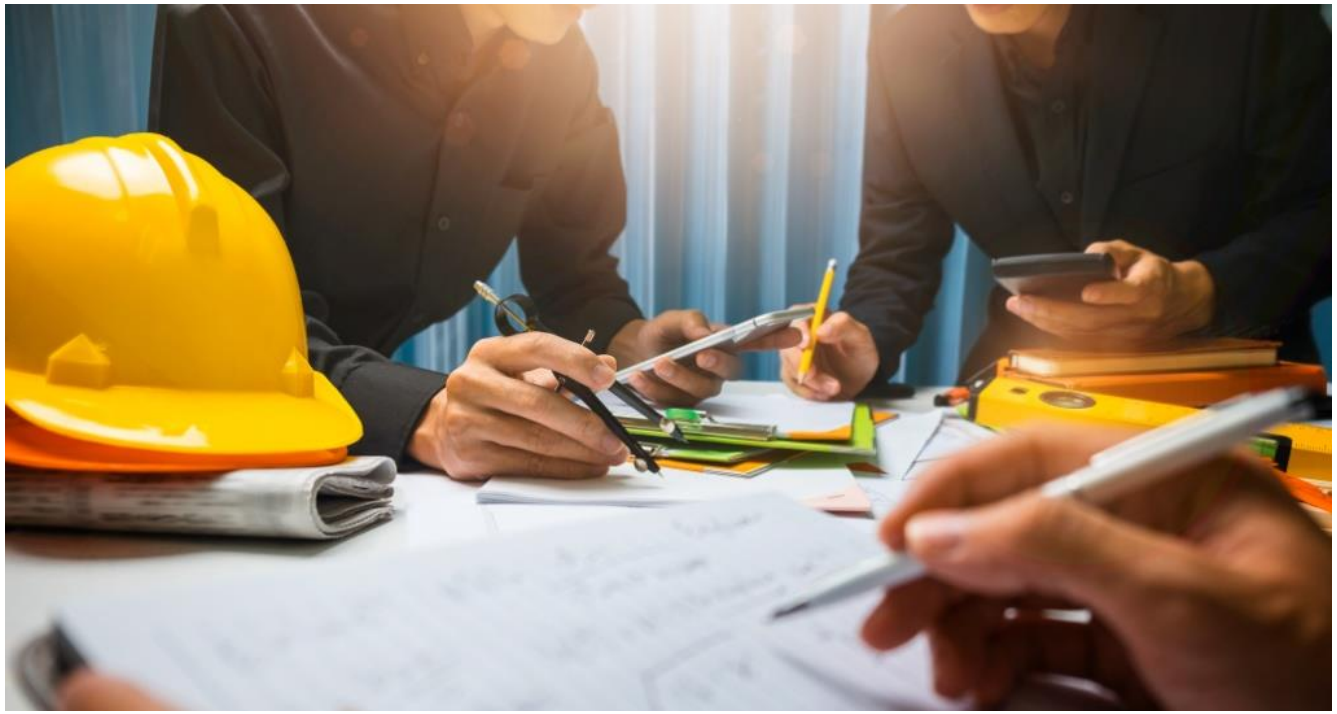


Source: Rumane (2011)



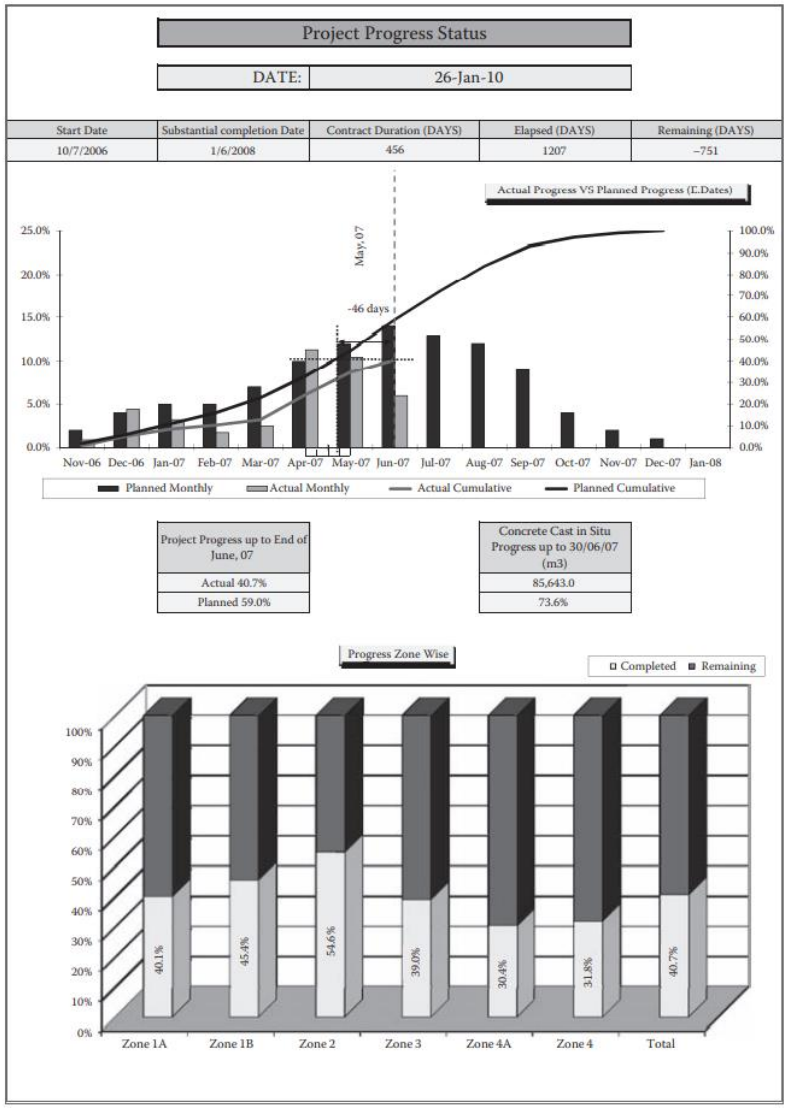
https://www.projectmanagementqualification.com/blog/2019/10/21/project-monitoring-control/

- Monitoring **is collecting, recording, and reporting information** concerning any and all aspects of project performance that the project manager or others in the organization need to know.



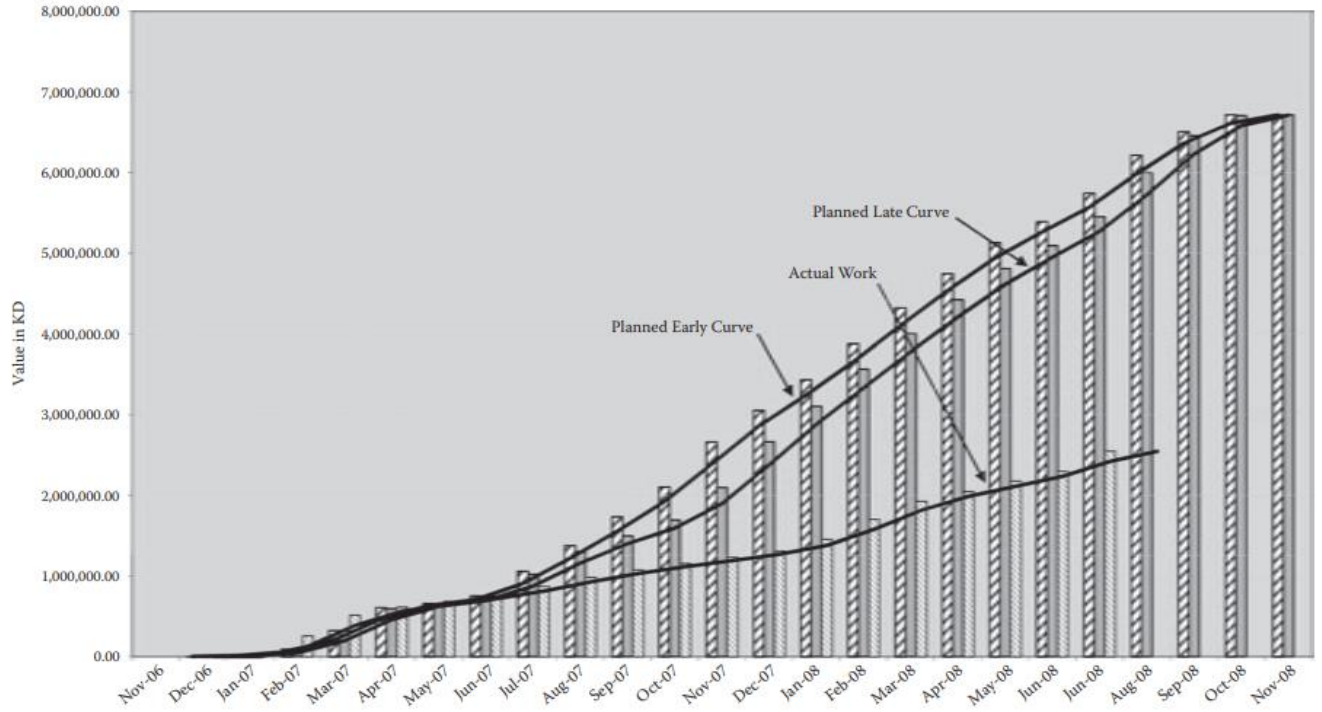
Source: Rumane (2011)

Project progress status



Source: Rumane (2011)

Comparison between planned versus actual work



	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08
Early Cumm		0	6392	26731	93560	32310	60900	66135	75392	10590	13776	17357	21066	26642	30560	34329	38797	43231	47454	51309	53921	57467	62175	65083	67159	67159
Late Cumm		0	6392	18596	70897	32194	59624	65561	73221	10214	13035	14969	16955	20981	26642	31049	35658	40004	44230	48072	50919	54492	60006	64559	67071	67159
Actual Cumm			0.00	0.00	25631	51539	61306	68808	75186	87286	98535	10749	11546	12318	13077	14542	17042	19282	20492	21772	22972	25472				

Source: Rumane (2011)

Progress Reports

- The contractor's daily progress is monitored through a **daily progress report** submitted by the contractor on the morning of the working day following the day to which the report relates.
- It gives the status of all the resources available on site for that particular day.

Source: Rumane (2011)

Daily progress reports

Project Name

Consultant Name

CONTRACTOR'S DAILY PROGRESS REPORT

Contract No.:- **Contract Day No.**

Contractor :- **Date**

SAMPLE FORM

This daily report to be completed on both sides and submitted to the Resident Engineer following the report date.

Contractor's Staff and Manpower Required			Contractor's Staff and Manpower Additional		
Job Description	No.	Actual	Job Description	Skilled	Un-skilled
Contractor's Representative	1		Secretary		
Project Manager	1		Store keeper		
Deputy Project Manager	1		Carpenter		
Planning Manager	1		Steel Bender		
Deputy Planning Manager	1		Concrete workers		
Quality Control Manager	1		Mason		
Quality Control Engineer	1		Plasterer		
Quantity Surveyor	1		Tiler		
Assistant Quantity Surveyor	1		Marble		
Site Engineer (Architect)	2		Ceramic		
Site Civil Engineer	2		Stone		
Site Engr. (Water & Sewerage)	2		Precast		
HVAC Engineer	2		Safety officer		
Mechanical/Fire Fighting Engr.	1		Painter		
Electrical Engineer	2		Plumber		
Communications Engineer	1		HVAC		
Site Engineer (Marine)	1		Fire system		
Site Engr. (Roads & Services)	1		Seaman (Diver)		
Material Engineer	1		Mechanical supervisor		
Assistant Material Engineer	1		Driver		
Landscape Gardner	1		Operator		
Safety Engineer	1		Welder		
Co-ordinator	1		Electrician		
Surveying Engineer	1		Mech. & Elec. Workshop labour		
Surveyor	1		Labour		
Supervisor	4		Others		
Computer Programmer	1				
Computer Draftsman	2				
Draftsman	1				
Laboratory Engineer	1				
Laboratory Technician	1				
	40				

Distribution

Original : Resident Engineer

CC : Owner

Contractor.....

Source: Rumane (2011)

Project Name

Consultant Name

CONTRACTOR'S DAILY PROGRESS REPORT

Contract No.:- **Contract Day No.**
Contractor :- **Date**

SAMPLE FORM

This daily report to be completed on both sides and submitted to the Resident Engineer following the report date.

Contractor's Plant and Equipment Required			Contractor's Plant and Equipment Additional	
Description of Item	No.	Actual	Description of Item	No.
Tower Crane	3		Loader	
Crane	4		Rock body truck	
Tipper Truck	12		Boat with crew and radio	
Excavator	4		Radio communication system	
Grader	2		Bob cat	
Well point system with WP.	4		Fork-lift	
Water Tanker	4		Crane	
Compactor (Plate)	8		Transit mixer	
Vibrator	8		Flat bed truck	
Conc. Testing Equipment	1		Floating crane 120 tonne	
Soil Testing Equipment	1		Pile driving machine	
Compressor	5		Side crane	
Transit Mixer	6		Tug	
Water Pump	2		Tractor	
Vibrator Compact Roller	4		Truck with crane	
Automatic Batching Plant	1		Gantry crane	
Concrete Pump	2		Buldozer	
Asphalt Roller	4		Pick-up	
Welding Machine	4		Car	
Generator	4		Bus	
Bulldozer	2		Mini bus	
Barge	1		Tug boat	
Split Barges	1		Motor grader	
Crane Pontoon	1			
Grab	2			
Diving Equipment	4			
Automatic Tide Gauge	1			

These items are provided by supplier

Distribution

Original : Resident Engineer Contractor.....

Source: Rumane (2011)

Project Name

Consultant Name

CONTRACTOR'S DAILY PROGRESS REPORT

Contract No.:- **Contract Day No.**
Contractor :- **Date**

SAMPLE FORM

This daily report to be completed on both sides and submitted to the Resident Engineer following the report date.

Material Delivered to the Site		
Description of Material	Quantity	Unit

Distribution
Original : Resident Engineer
CC : Owner

Contractor.....

Source: Rumane (2011)

Work in progress

Project Name
Consultant Name

WORK IN PROGRESS REPORT

Contract No.: **Contract Day No. :**
Contractor: **Date :**

On Site Activities									
During the Day					Expected Next Day				
No.	Description	Area	Unit	Qty.	No.	Description	Area	Unit	Qty.

SAMPLE FORM

Reasons for Delay, if any.

Off Site Work/Activities							
During the Day				Expected Next Day			
No.	Subcontractor Name	Work Description	Qty.	No.	Subcontractor Name	Work Description	Qty.

Reasons for Delay,if any.

Source: Rumane (2011)

Daily checklist status

Project Name
Consultant Name

DAILY CHECKLIST STATUS

Contract No.: **Contract Day No. :**
Contractor: **Date :**

Sr.No.	Checklist No.	Description	Activity	Area/Location	Action	Remedial Action*	Remark

SAMPLE FORM

* For Not Approved Checklist

Source: Rumane (2011)

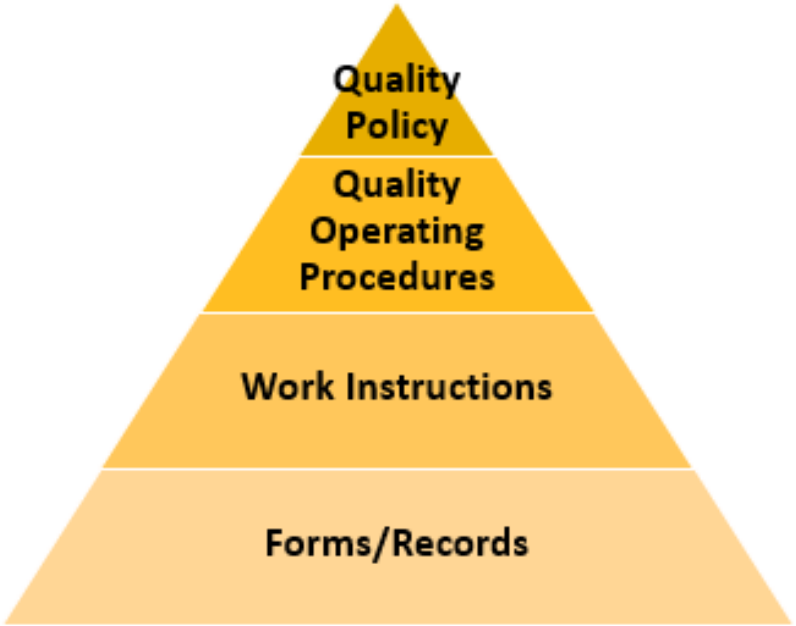
Quality Control

- The construction project **quality control process** is the part of the contract documents.
- The purpose of quality control during construction is to **ensure that the work is accomplished in accordance with the requirements specified in the contract**.

Source: Rumane (2011)

ISO 9000 Quality Management System

- ISO 9000 quality system standards are a tested framework for taking a systematic approach to managing the business process so that organizations turn out products or services conforming to customer's satisfaction.



Source: Rumane (2011)

ISO 14000 Environmental Management System

- ISO 14000 is a series of international standards that have been developed to incorporate **environmental aspects** into business operations and product standards.

Source: Rumane (2011)

Occupational Health and Safety Assessment Series (OHSAS) 18000

- Developed to help organizations control and minimize occupational **health and safety risks**.

Source: Rumane (2011)

Inspection

- **Inspection** is the process by which ongoing and completed work is examined.
- Inspection is ongoing or **"after-the-fact"** while control is **"preventive“**.

Source: Rumane (2011)

Testing

- Testing is an extremely important part of CQM.
- If tests are not performed properly, there are many construction procedures and materials that cannot be confirmed as adequate.
- Visual observation alone is insufficient.

Source: U.S. Army Corps of Engineers (2004)

Inspection and testing stages

- **During the construction process**. This is carried out with the checklist request submitted by the contractor for testing ongoing work before proceeding to the next step.
- **Receipt of subcontractor or purchased material or services**. The contractor submits a material inspection request to the consultant upon receipt of material.
- **Before final delivery or commissioning and handover**.

Source: Rumane (2011)

Material inspection report

Project Name

Consultant Name

CONTRACT No.:

CONTRACTOR :

MATERIAL INSPECTION REPORT

Description of material for inspecition: -

MIR No. :

Date :

Contract No. :

Transmittal No. :

Spec/Drg.ref. :

Qty. required	Qty. delivered	Total delivered	Attachements

SAMPLE FORM

Inspection Location : Date of Material Delivery :

Contractor's Comments: -

Contractor's Signature : ..... Date :

Inspection Comments :

Comply with Approved Transmittal: YES ☐ NO ☐

Signature of Inspection Engineer : ..... Date : .....

Signature of R.E. : ..... Date : .....

Source: Rumane (2011)

Checklist for form work

Project Name

Consultant Name

QUALITY CONTROL OF FORMWORK / FALSEWORK / DIMENSIONS / LEVELS

CONTRACTOR: **DATE :** / /

CONTRACT NO:

Site Engineer : _____

Inspected Element : _____

(N.B.: This form is to be prepared by the Site Engineer and submitted to the R.E.)

(A=Acceptable, N=Needs Adjustment, U=Unsatisfactory)

1) Form Dimensions & Levels :

		A	N	U
1.1	Setting Out			
1.2	Top of Concrete Level Ready for Casting			
1.3	Dimensions			
1.4	Heights & Levels			
1.5	Chamfers			

SAMPLE FORM

2) Falsework :

		A	N	U
2.1	Supports			
2.2	Rigidity			
2.3	Bracing			
2.4	Screw Jacks			
2.5	Timber Straightness			
2.6	Splices of Vertical Members			

3) Formwork :

		A	N	U
3.1	Rigidity			
3.2	Water Tightness			
3.3	Steel Bolts / Rods / Ties			
3.4	Openings & Inserts			
3.5	Cleanliness			
3.6	Oiling			
3.7	Working Platforms and Walkways			

R.E's Comments :

Signature of Resident Engineer _____ **Date :** _____

Source: Rumane (2011)

Checklist for electromechanical work

Project Name

ON SITE TESTING OF ELECTRO-MECHANICAL WORKS

CONTRACTOR : _____ CHECK LIST No. : ☐

SUBCONTRACTOR: _____ DATE ☐

FOLLOWING WORKS ARE READY FOR INSPECTION ON: _____ TIME: _____

☐ ELECTRICAL ☐ MECHANICAL

LOCATION: _____ DRAWING REF: _____

SPECIFICATION NO : _____ DIVISION : _____ SECTION : _____

SAMPLE FORM

Description of Work/System:

TEST PROCEDURE: YES ☐ NO ☐

METHOD STAEMENT: YES ☐ NO ☐

CONTRACTOR SIGNATURE: _____ DATE: _____

A/E REMARKS:

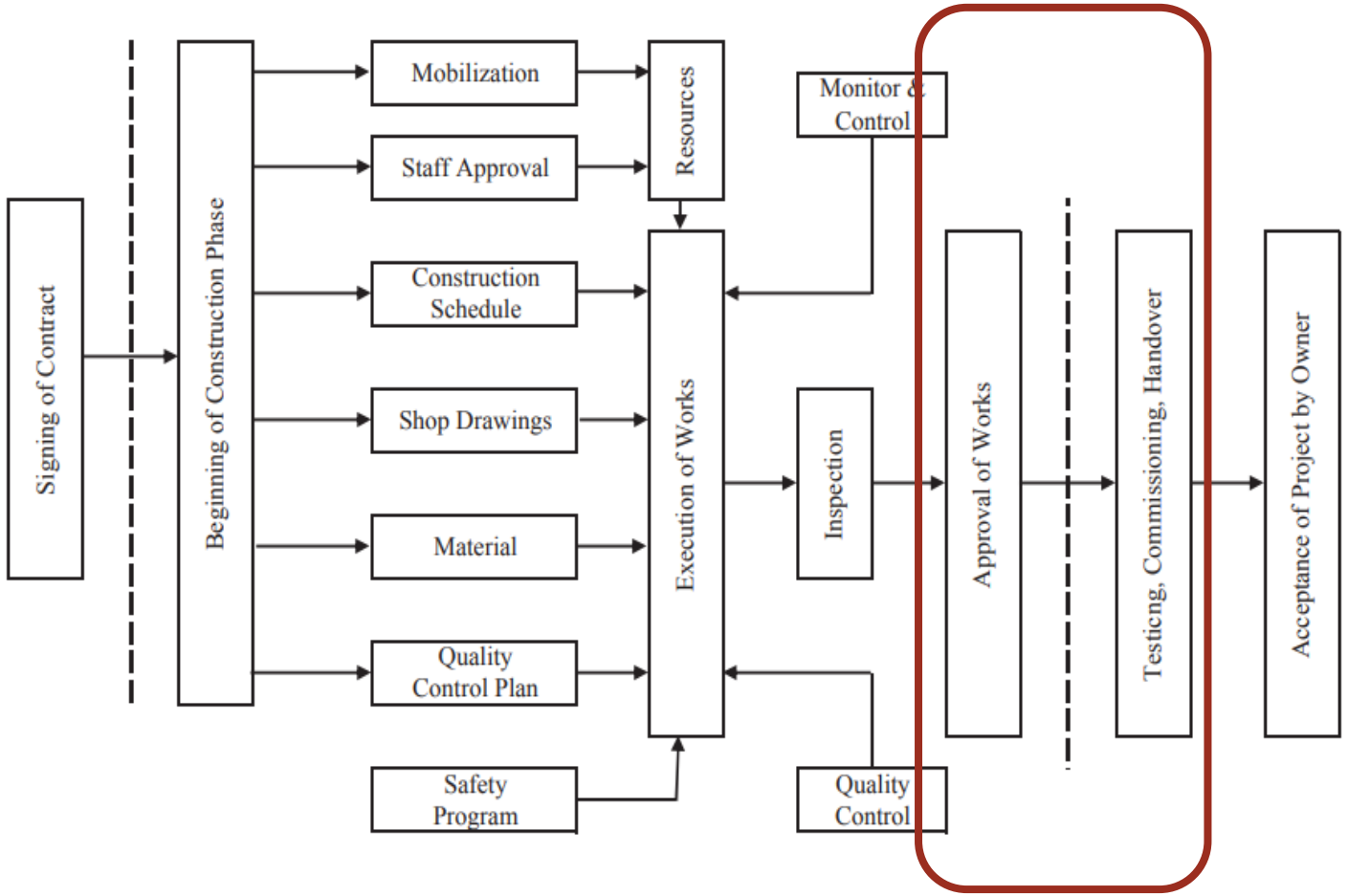
CONSULTANT ENGINEER: _____ RESIDENT ENGINEER: _____

DATE: _____ DATE: _____

Distribution ☐ OWNER ☐ R.E. ☐ CONTRACTOR

Source: Rumane (2011)

Major activities during the construction phase



Source: Rumane (2011)

Final testing, Commissioning, and Handover

- During this period, the project is transferred/handed over to the owner/end user, and a substantial **completion certificate** is issued to the contractor.

Source: Rumane (2011)

Main activities

- Commissioning of the project
- Obtaining authorities’ approval
- Handing over technical manuals, documents, and as-built drawings to the owner/owner’s representative.
- Handover.

Source: Rumane (2011)

Commissioning

- **Commissioning** is the orderly sequence of testing, adjusting, and balancing the system and bringing the systems and subsystems into operation.

Source: Rumane (2011)

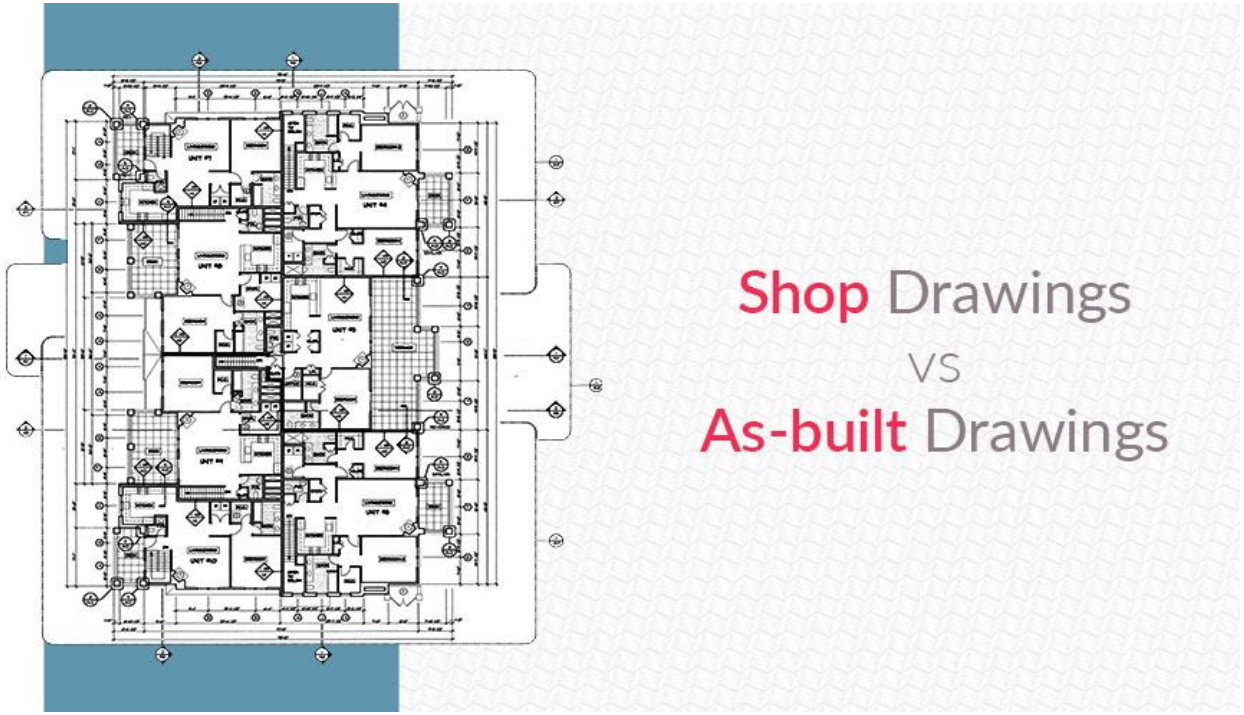
Authorities' Approval

- Necessary regulatory approvals from the respective concerned authorities are obtained so that owner can occupy the facility and start using/operating it.
- It is also required that the building/facility be certified by the related fire department authority/agency that it is safe for occupancy.

Source: Rumane (2011)

As-Built Drawings

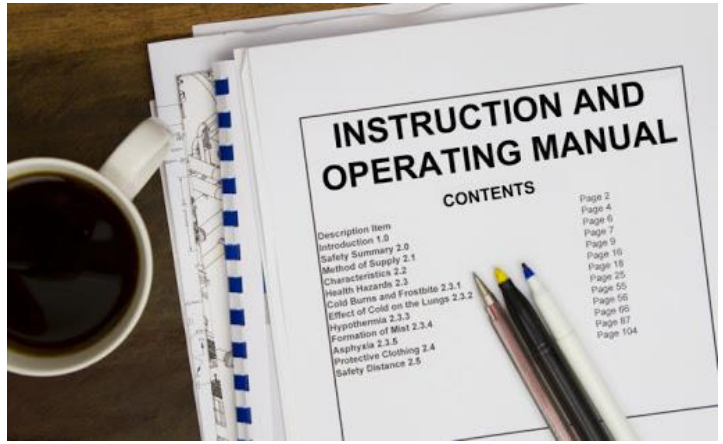
- As-built drawings are prepared by incorporating all the modifications, revisions, and changes made during the construction.



Source: Rumane (2011)

Technical Manuals and Documents

- Technical manuals, design and performance specifications, test certificates, and warranties and guarantees of the installed equipment are required to be handed over to the owner as part of the contractual conditions.



Source: Rumane (2011)

Handover of Facility to Owner/End User

- Once the contractor considers that the construction and installation of works has been completed per the scope of contract, final tests have been performed, and all the necessary obligations have been fulfilled, the contractor submits a written request to the owner/consultant for handing over of the project and for issuance of substantial completion certificate.

Source: Rumane (2011)

Handing over certificate

Project Name

Project Name

HANDING OVER CERTIFICATE

CONTRACTOR : _____ CERTIFICATE No. : ☐

SUBCONTRACTOR: _____ DATE ☐

SPECIFICATION NO : _____ DIVISION : _____ SECTION : _____

DRAWING No. BOQ REF: _____

AREA : ☐ Building Works ☐ Electrical Works ☐ Mechanical Works

☐ HVAC Works ☐ Finishes Works ☐

SAMPLE FORM

Description of Work/System:

The work/system mentioned above is completed by the contractor as specified and has been inspected and tested as per contract documents.The work/system is fully functional to the satisfation of owner/end user.The contractor hand over the said work/syster the owner/end user as on ----------.The guarentee/warranty of work/system shall start as of ---------- and shall be valid for a period of ----------years(duration) from the date of issuance of substantial completion certificate.The contractor shall be liat contractually till the end of warranty/guarentee period.

SIGNED BY:

OWNER/END USER: _____ CONTRACTOR: _____

CONSULTANT: _____ SUBCONTRACTOR: _____

Source: Rumane (2011)

Summary

- A majority of total project budget and time is used during construction.
- Daily monitoring and control is necessary
- Daily monitoring and control of resources and activities is necessary to achieve objectives of the project.
- Construction companies use quality assurance standards in their activities (ISO 9000, ISO 14000, OHSAS 18 000).
- Quality has to be controlled and assured from the mobilization to handover stages.

Thank you for your attention!

Questions?