

Pre Commissioning, Commissioning, Start-up & S/D Procedures

OGS-ZTP-GT-TRM-0013

MAIN TOPICS

1. INTRODUCTION

Project Phases

Project Commissioning

Complex Projects

2. 9 Key Elements for Successful Plant Commissioning.

Commissioning Definition

Commissioning Planning

Mech. Completion

P&ID Checking

Pre-Commissioning

Commissioning

Start-up

Initial Operation

Performance Test

Post Commissioning

3. Mechanical Completion Activities

Mech. Activities

Piping Activities

4. Mechanical Completion Documents

5. Check List for Mech. Completion

INTRODUCTION


Project Phases



INTRODUCTION

PROJECT COMMISSIONING: is the process of **assuring** that all systems and components of the plant are designed, installed, tested, operated, and maintained according to the operational requirements of the owner or final client. A commissioning process may be applied not only to new projects but also to existing units and systems subject to expansion, renovation or revamping.

COMPLEX PROJECTS, the large volume and complexity of commissioning data, together with the need to guarantee adequate information traceability, normally leads to the use of powerful IT tools, known as “Completion Commissioning Management Systems **CCMS**”, to allow effective planning and monitoring of the commissioning activities.



WWW.

The **9** Key Elements
of
Successful
Plant Commissioning

Element 2
- MECHANICAL COMPLETION -

Definition

Checking and testing of equipment and construction to confirm that the installation is in accordance with drawings and specifications and ready for pre-commissioning **OR** commissioning in a safe manner and in compliance with project requirements.

Typical Tasks

Mechanical ⊕

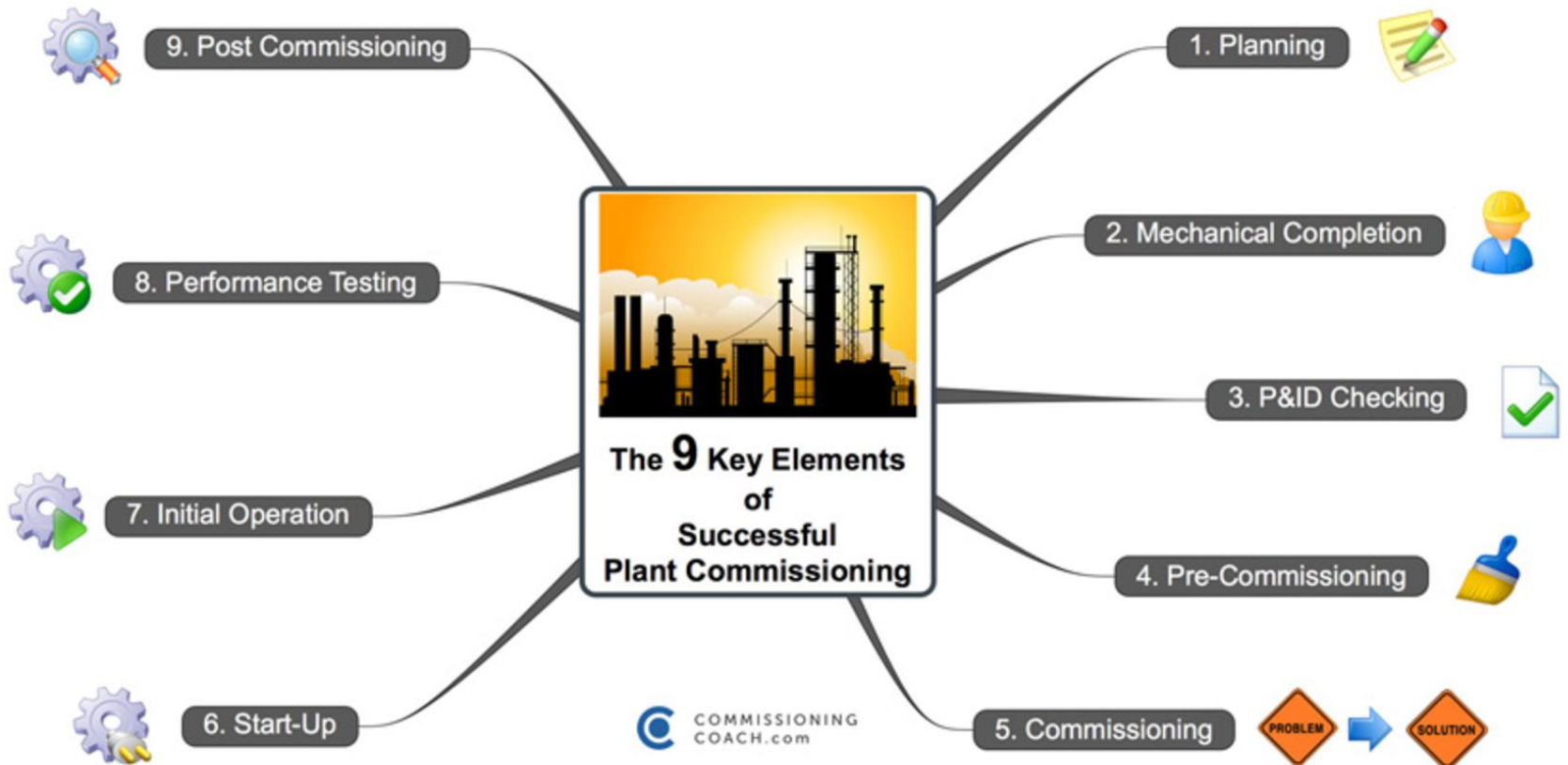
Piping ⊕

Structural ⊕

Electrical ⊕

Instrumentation ⊕

The 9 Key Elements of Successful Plant Commissioning



1. Planning

Without proper planning you will not be able to commission the plant safely and on time

2. Mechanical Completion

This is the time when commissioning team take the system from construction team

3. P&ID Checking

Commissioning Engineers to verify that every thing in the plant is according to specification
Conformity check, punch list.

4. Pre-Commissioning

Includes cleaning of pipes, flushing, blowing, cleaning of vessels and tanks,
test of electric motors and instrumentation.

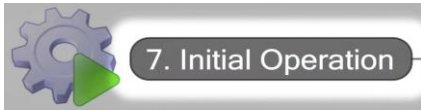
5. Commissioning

Includes introduction of utilities, cold and hot running trials, process fluid test, solvent
dynamic testing...lot of problems to be solved, The utilities must be already tested and in service



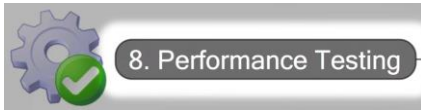
6. Start-Up

The entire plant to be taken slowly to full operation



7. Initial Operation

This phase is necessary to perform performance test. During this phase the plant will be optimized,



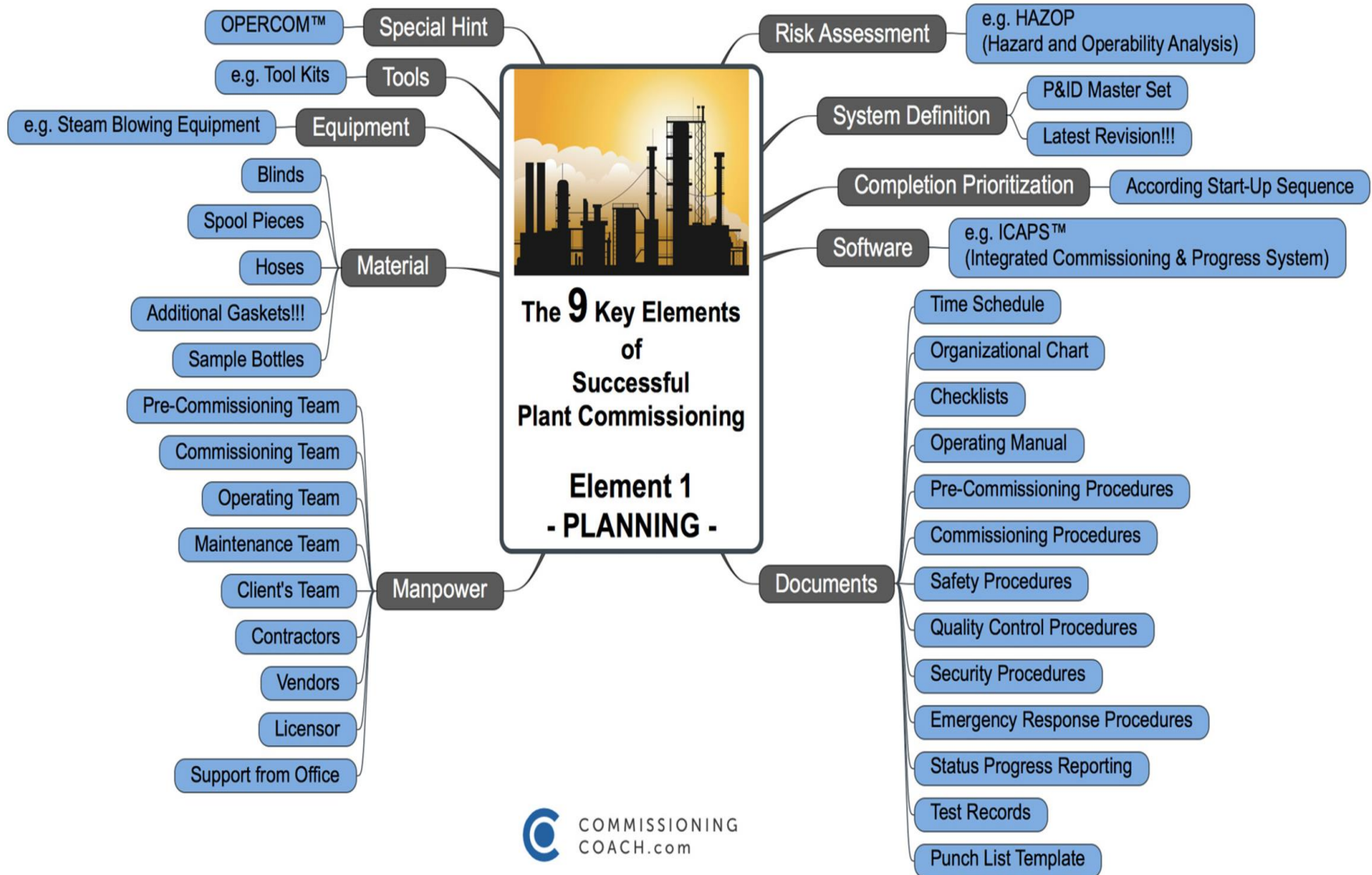
8. Performance Testing

It is a big moment for all commissioning team. Now needs to prove that the plant meet the specification and normal operating conditions



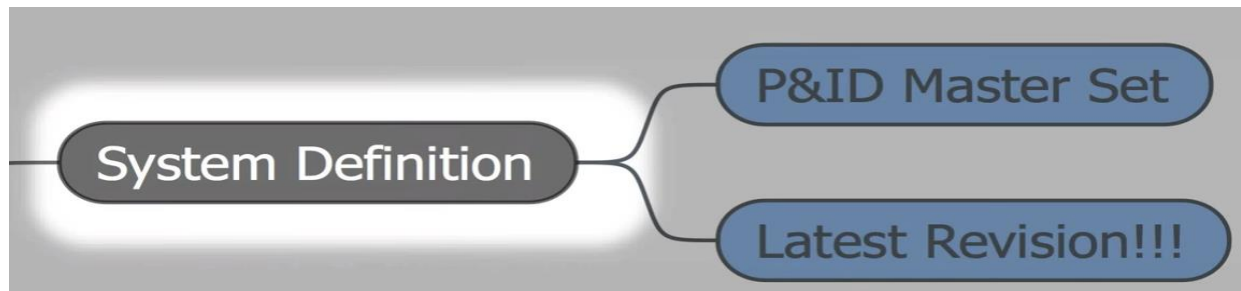
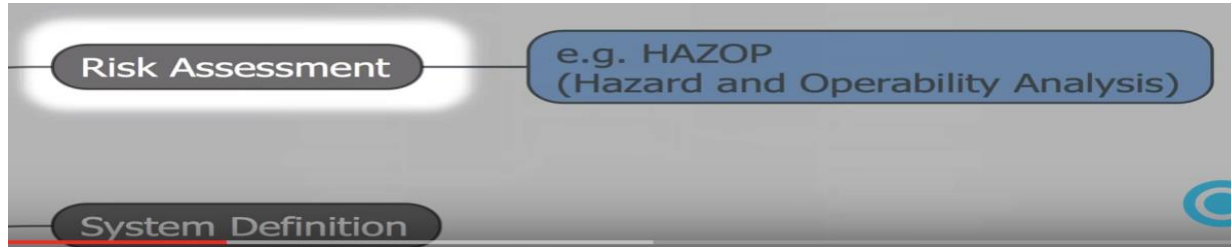
9. Post Commissioning

In post commissioning phase reduced commissioning staff, also it's a punch point and do not under estimate the time required to complete post commissioning activities.



1- Planning:

- The first priority for the commissioning is safety



- Pre-commissioning and commissioning should be carried-out system by system and unit by unit basis
Each unit should be divided to process and OR piping and equipment system and sub-system.
- On the master As-Built P&ID mark system by system using different color.
- Be sure that you are using last revision

Completion Prioritization

According Start-Up Sequence

- Using right order of the commissioning of the system.
- Which unit do I need and when.
- i.e. Utility system required early like plant air, instrument air, Nitrogen and steam before any process system.

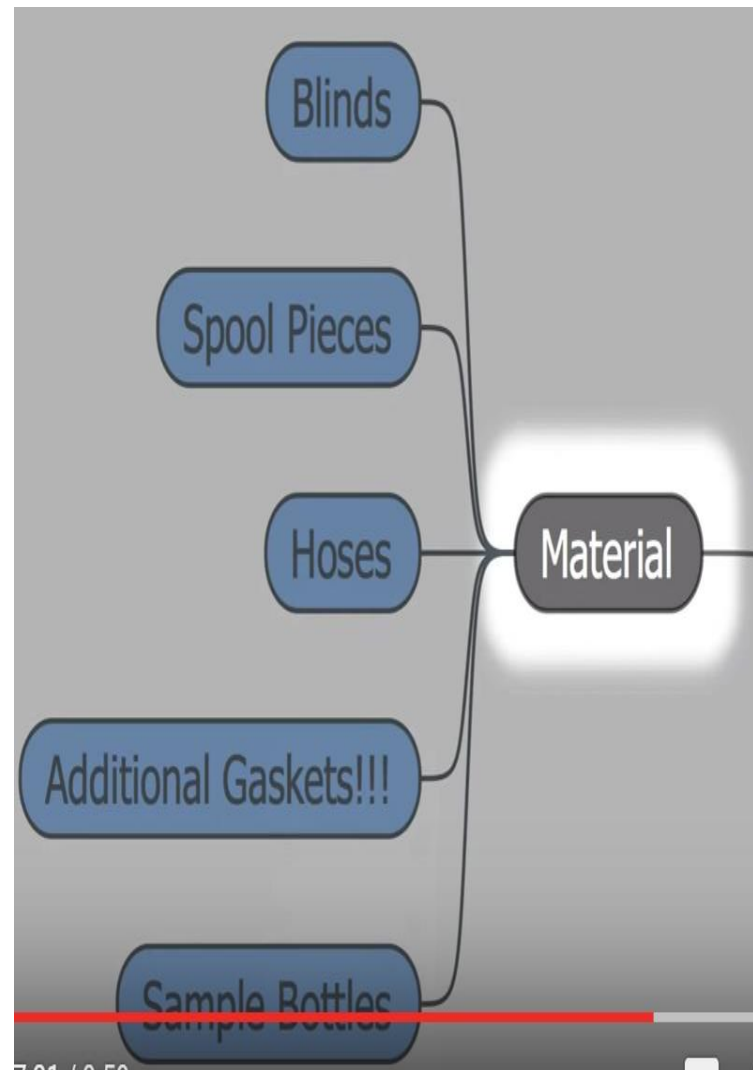
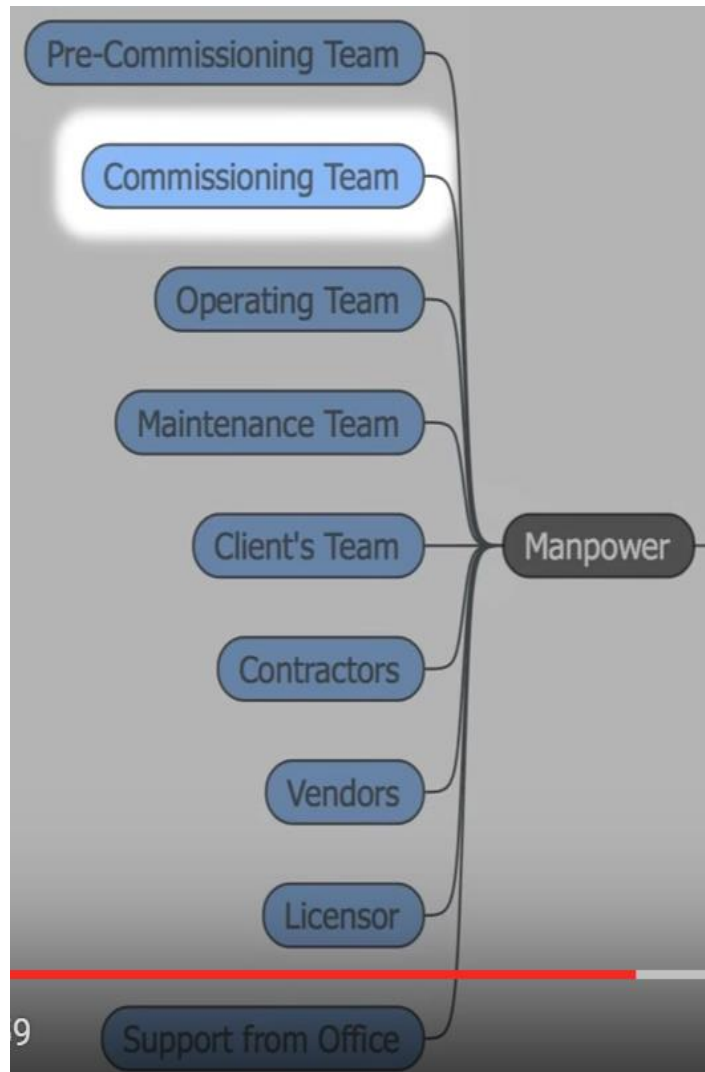
Software

e.g. ICAPS™
(Integrated Commissioning & Progress System)

- You have to consider which software you will use to record commissioning progress

Documents should be prepared before commissioning team to be in site



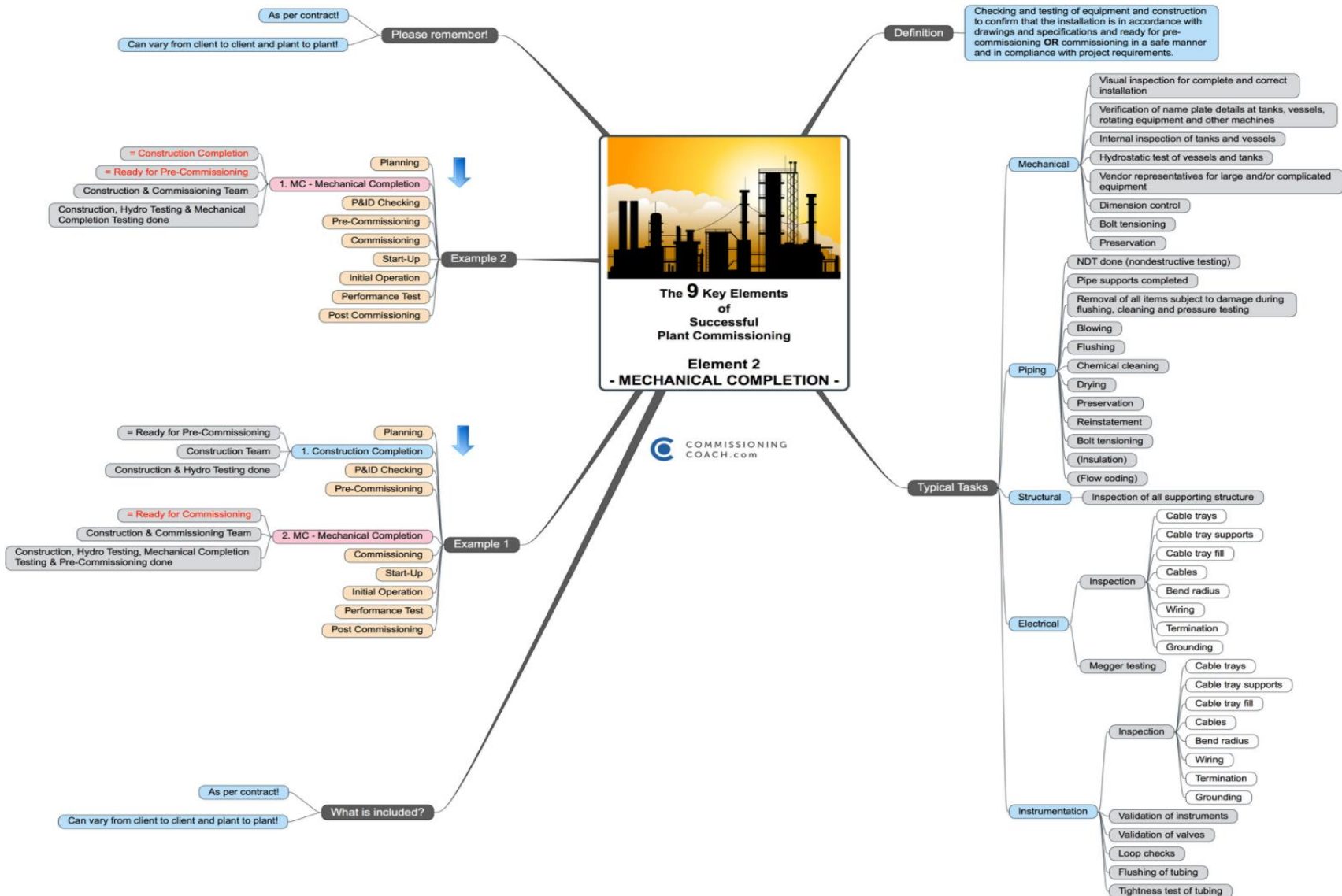


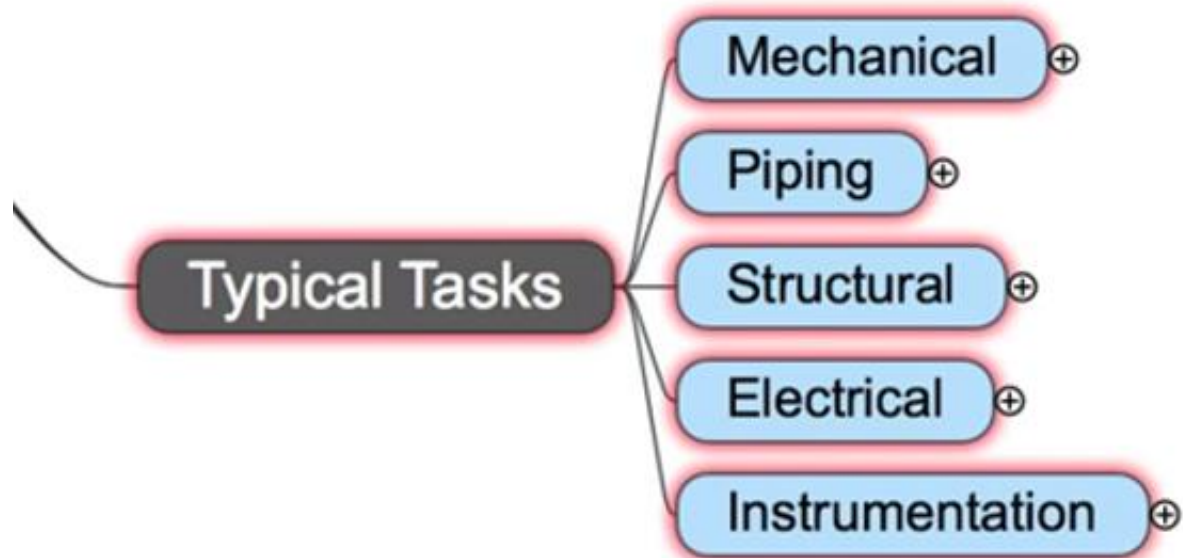
e.g. Steam Blowing Equipment

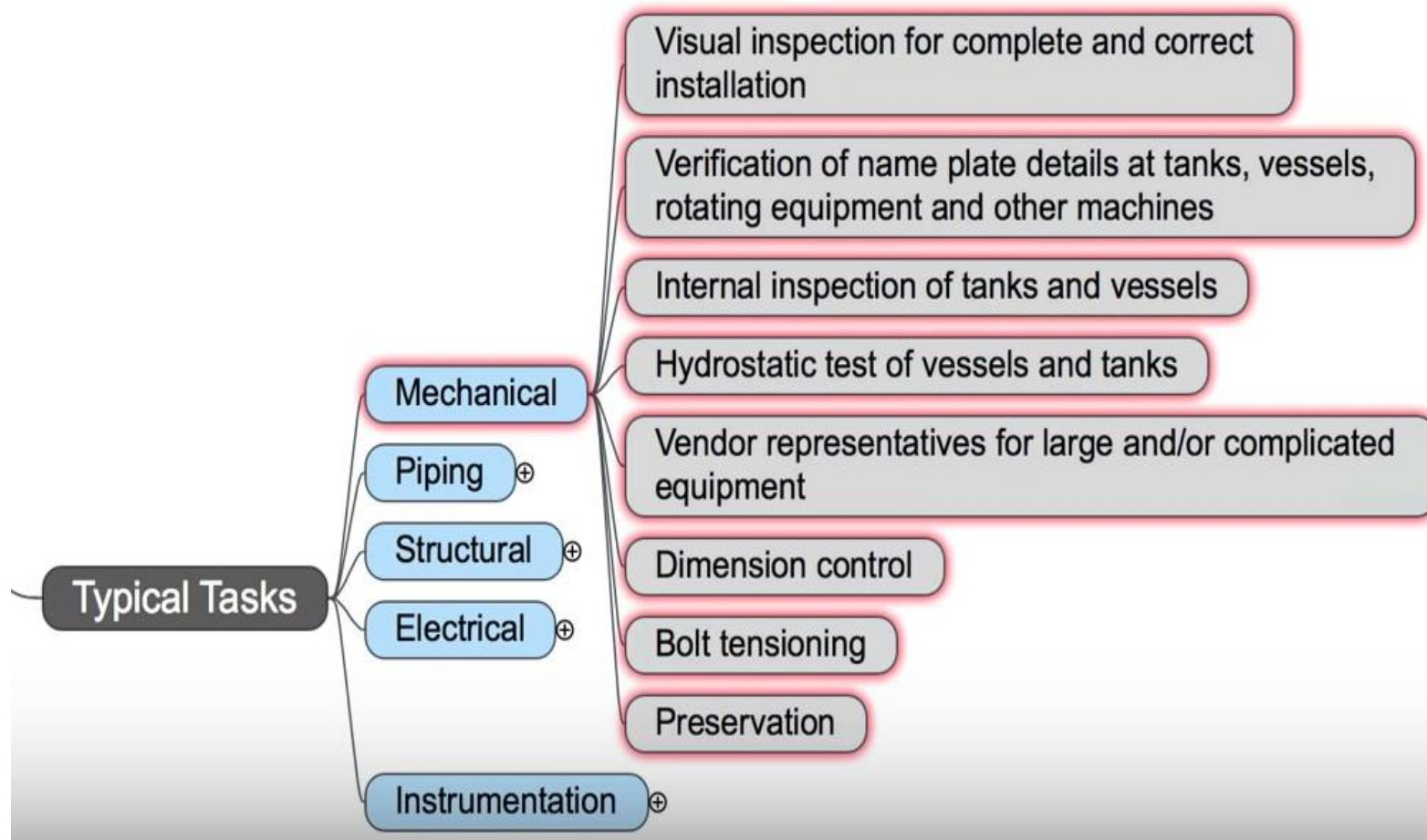
Equipment

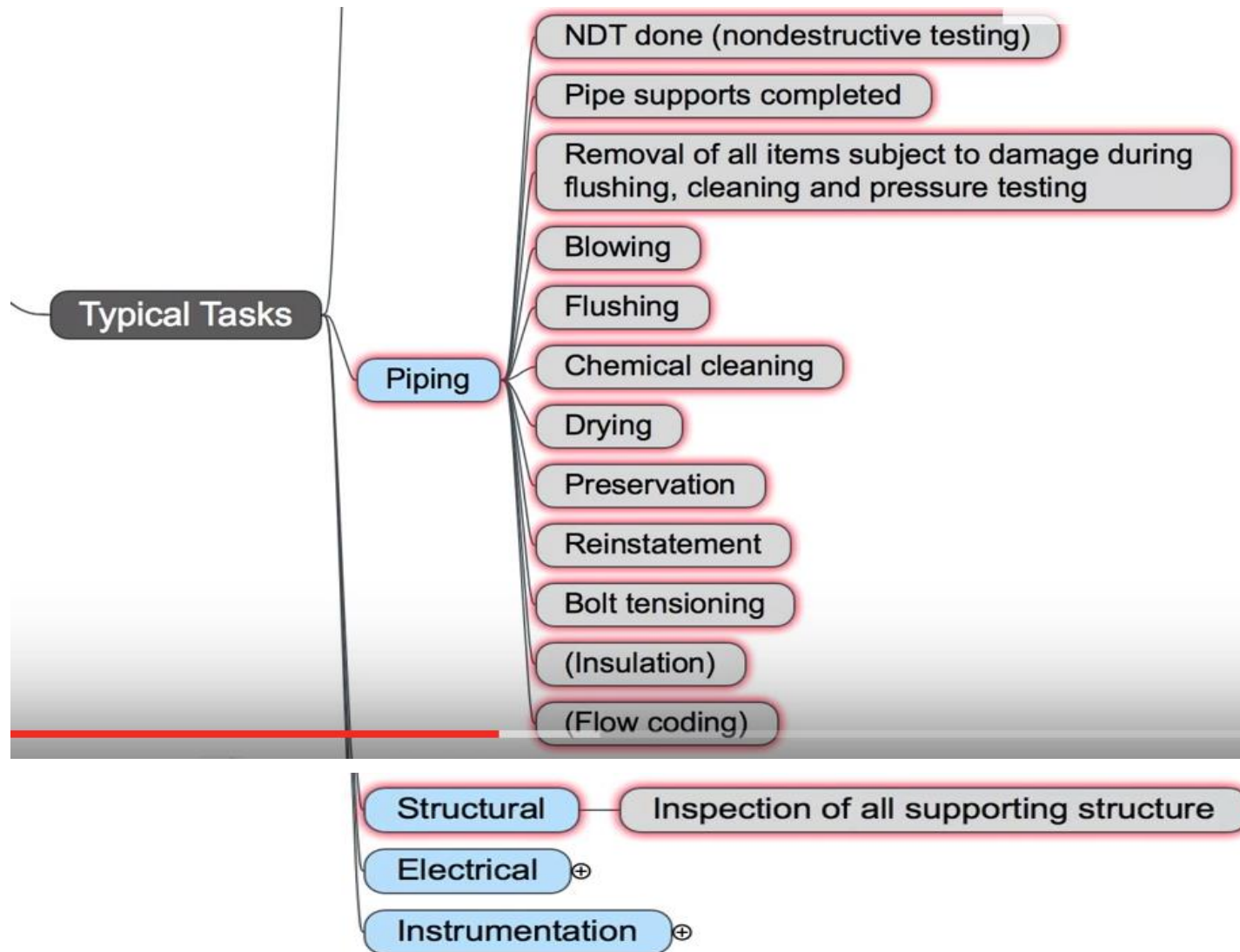
e.g. Tool Kits

Tools

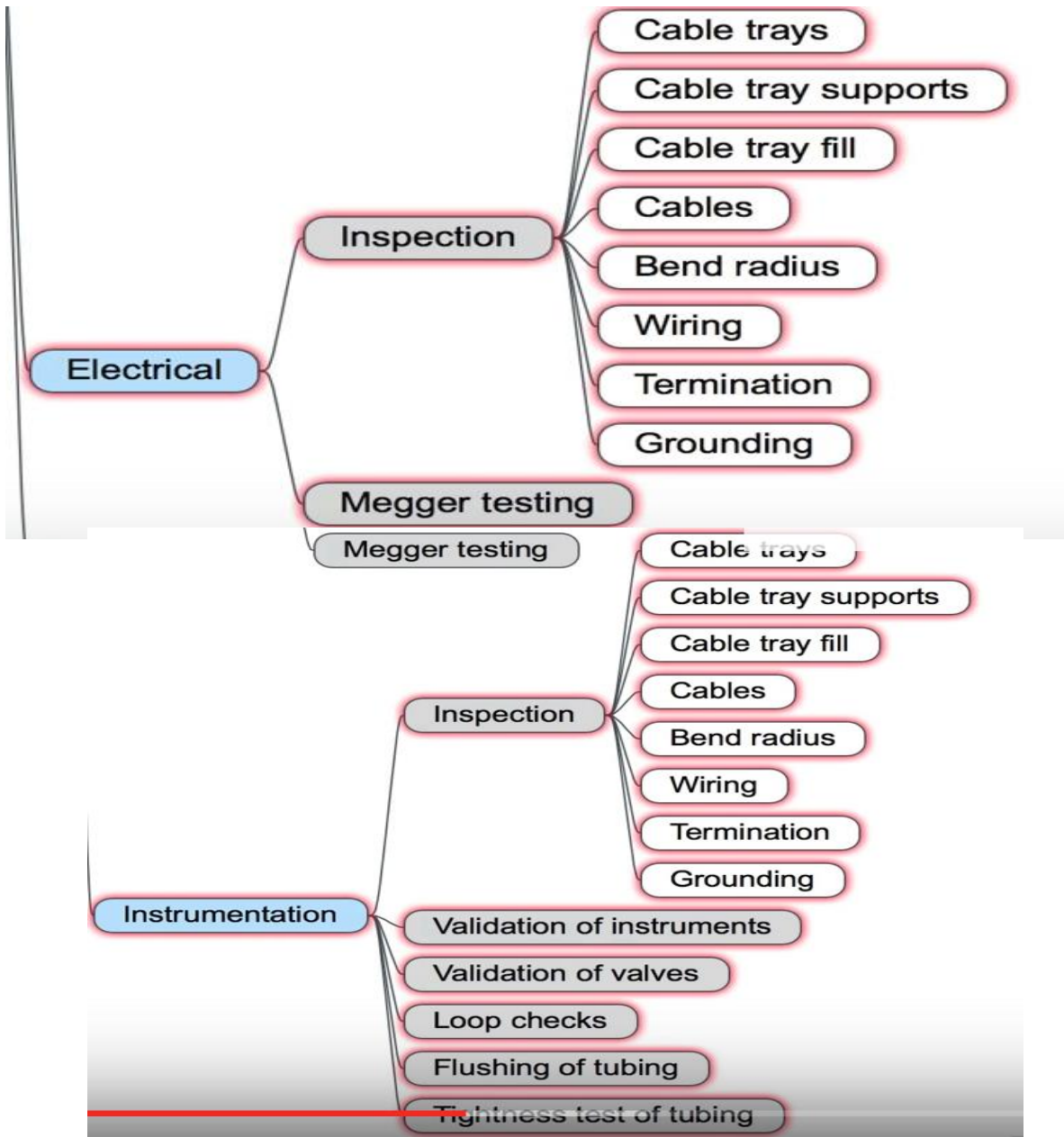




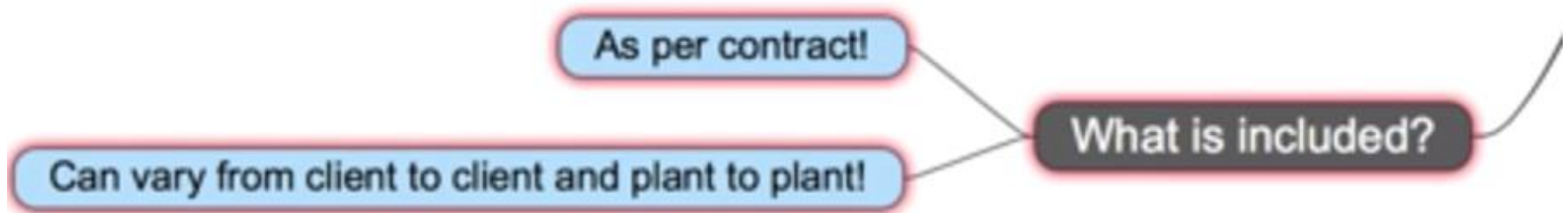


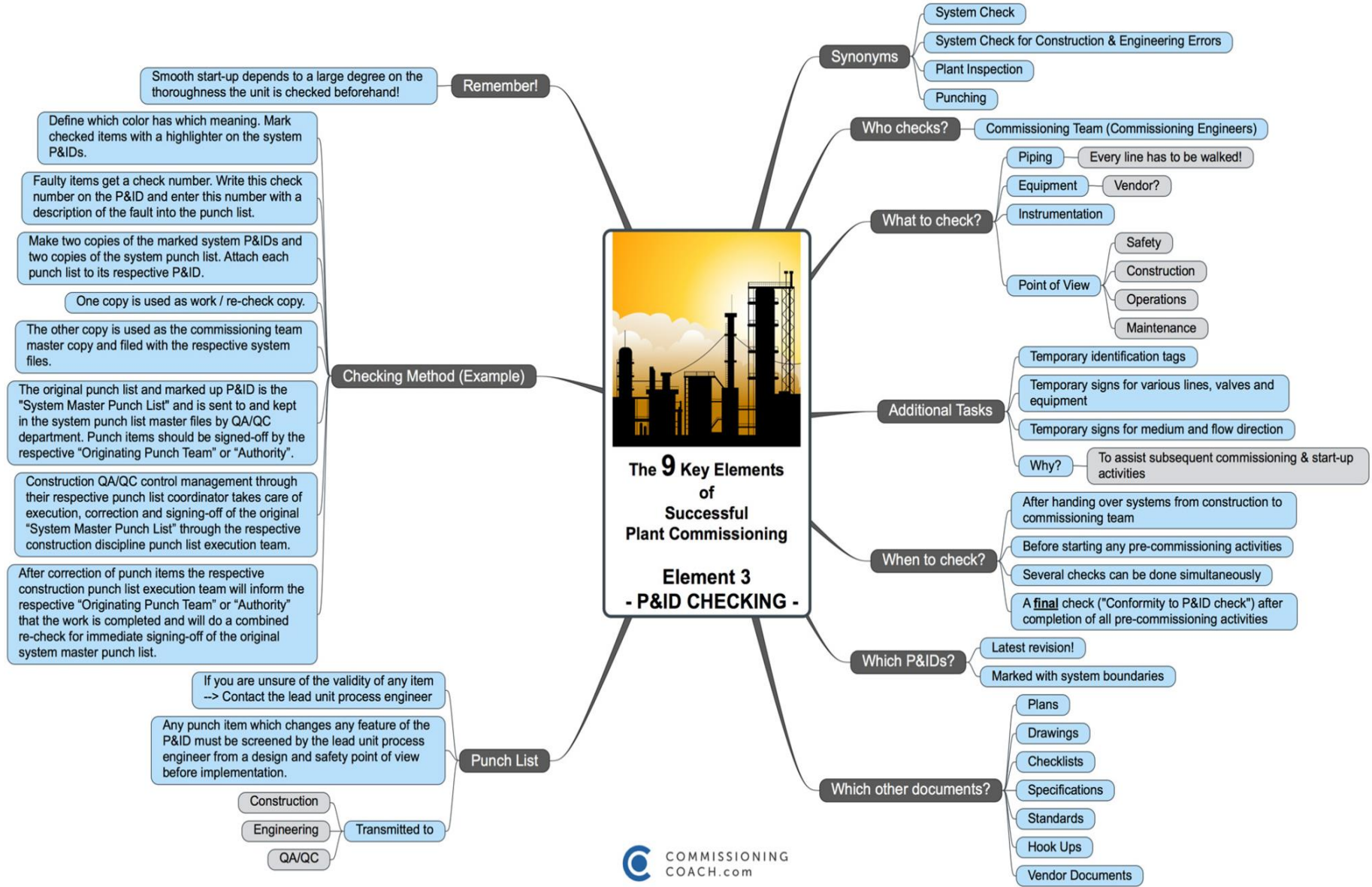


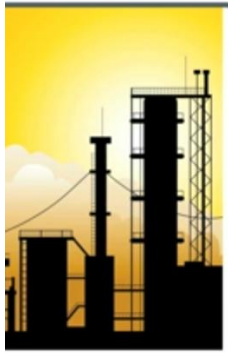
N.B: Blowing, Flushing, Chemical cleaning, Drying to be included in the Pre- Commissioning Operations



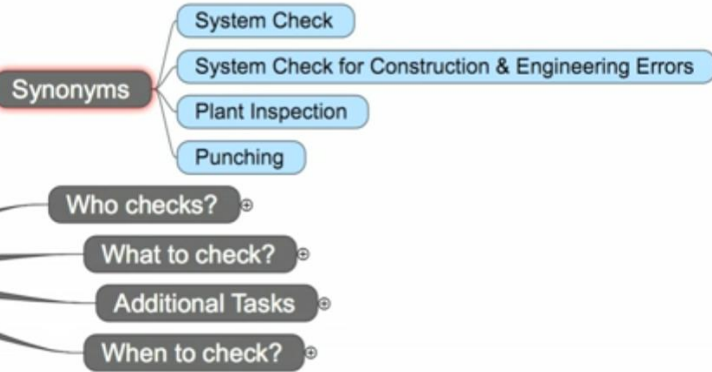
What Activities Can be Included in Mechanical Completion







Key Elements



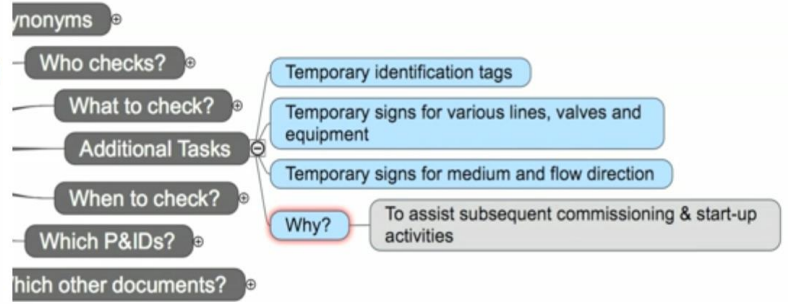
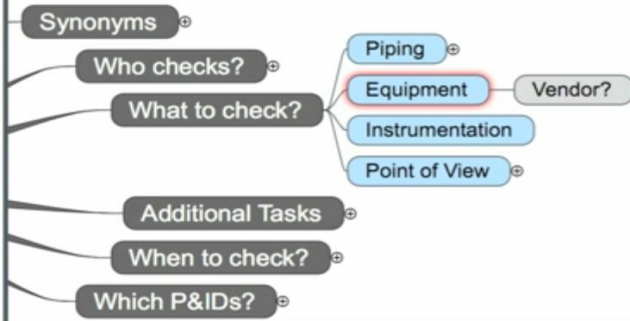
Elements

Successful Commissioning



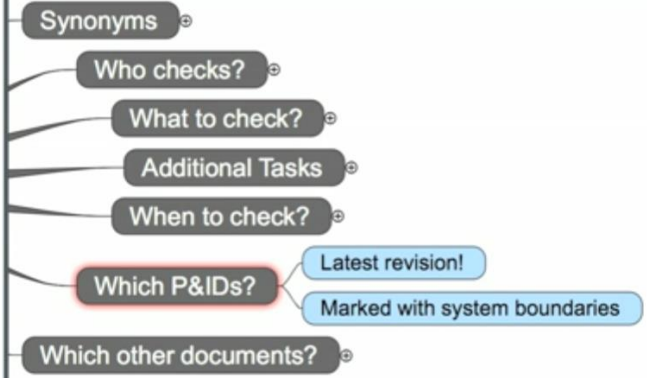
Elements

Final



Elements

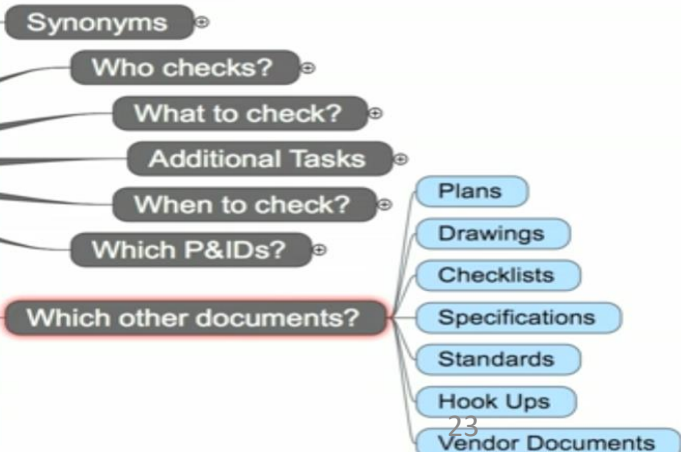
Commissioning

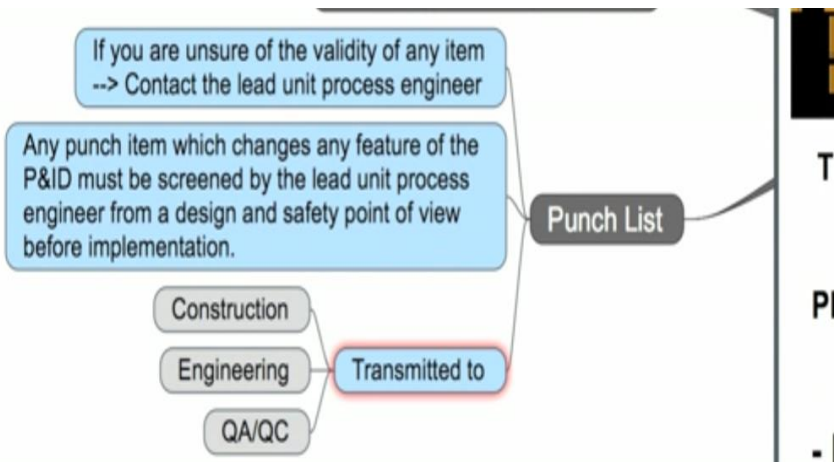


Documents

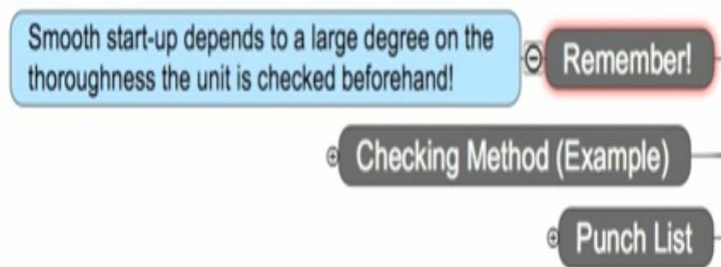
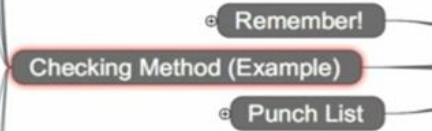
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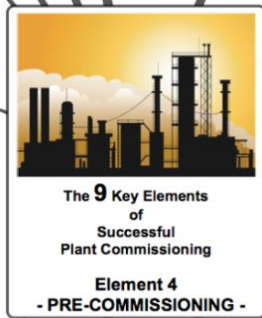
Documents





- Faulty items get a check number. Write this check number on the P&ID and enter this number with a description of the fault into the punch list.
- Make two copies of the marked system P&IDs and two copies of the system punch list. Attach each punch list to its respective P&ID.
 - One copy is used as work / re-check copy.
 - The other copy is used as the commissioning team master copy and filed with the respective system files.
- The original punch list and marked up P&ID is the "System Master Punch List" and is sent to and kept in the system punch list master files by QA/QC department. Punch items should be signed-off by the respective "Originating Punch Team" or "Authority".
- Construction QA/QC control management through their respective punch list coordinator takes care of execution, correction and signing-off of the original "System Master Punch List" through the respective construction discipline punch list execution team.
- After correction of punch items the respective construction punch list execution team will inform the respective "Originating Punch Team" or "Authority" that the work is completed and will do a combined re-check for immediate signing-off of the original system master punch list.





What is Pre-Commissioning?

The term Pre-Commissioning is used for activities after construction completion, such as cleaning, catalyst loading, dry-runs and checks within the systems in order to prepare these items/systems for the next step - commissioning.

Pre-Commissioning activities can be done after or as well before mechanical completion (MC).

API Recommended Practice 1FSC

"Group of energized and static tests that constitute verification that the equipment or component is fabricated, installed, cleaned, and tested in accordance with the design and ready for commissioning."

Also: "static commissioning"

Pre-Commissioning Activities (Examples)

- Flushing, blowing and drying activities
- Chemical cleaning
- Final inspection and closing of vessels and tanks
- Final reinstatement of systems or sub-systems
- Air tightness "Leak" testing of systems
- Lubricants application
- Pre-commissioning "Run-in" of major rotating equipment and electrical motors
- Installation of filters
- Packing of distillation columns
- Loading of catalyst and molecular sieve beds
- Refractory dry-out (if possible - mostly commissioning activity)
- Vendor and factory acceptance testing
- Instrument, electrical and motor loop testing
- Punchlisting (ongoing process)

Pre-Commissioning Sequence (Example)

1. Power and control system (electrical sub-stations)
2. Building power, HVAC, fire & gas protection
3. DCS and PLC systems and instrumentation
4. Raw water and fire fighting systems
5. Waste water treatment systems
6. City sewer / clean sewer systems and chemical sewers & neutralization pits
7. Service water / potable water / cooling water systems
8. Instrument air / plant air and regeneration air systems
9. Water treatment systems, demineralization units and boiler water system
10. Nitrogen system
11. Flare system
12. Plant safety equipment and fire & gas detection
13. Fuel gas and fuel oil system
14. Slop systems
15. Flushing oil system
16. Boiler systems with steam & condensate networks
17. Amine, aromatics and caustic drain systems
18. Feed & product storage systems
19. Product & feed systems
20. Sour water treatment section and chemical handling treatment section
21. Amine treatment section
22. All process systems in order of "priority"

Milestone "Ready For Commissioning"

Pre-Commissioning activities are completed and the systems are ready to commence commissioning.

RFC

"Minor milestone in project when pre-commissioning activities for a discipline (electrical, instrumentation, mechanical, piping, etc.) are essentially complete and ready to commence commissioning."

API Recommended Practice 1FSC

Protocol

Final inspection of "critical" equipment installation

Supervision of catalyst and chemical loading

Licensor

For major items of rotating machinery, major utility systems and special electrical and instrument control equipment

Vendor Specialists

Package units

Request for mechanical completion acceptance

Mechanical completion certificate

Release for pre-commissioning notice

Punchlist report of outstanding punch points

Pre-Commissioning Additional Records

Pre-commissioning activity test records are prepared to record the satisfactory completion of various system preparation tasks & activities.

Pre-Commissioning Test Records

- Cleaning
- Chemical cleaning
- Drying
- Air tightness test
- Loading of catalysts
- Blinds list
- Performance Indicators
- Stationary equipment pre-commissioning activities
- Rotating equipment pre-commissioning activities
- Instrumentation pre-commissioning activities
- Tightness tests
- Reporting
- Total / Completed / Remaining
- Construction QA/QC documentation
- Systems punchlist (commissioning punch)
- Piping pre-commissioning activities

Pre-Commissioning Checklists

- Many different checklists for different types of equipment
- To record the inspection and status of equipment items within the plant
- To conform readiness for commissioning
- Often to be witnessed by client, PMC & licensor

Pre-Commissioning Procedures (Examples)

- Spectacle blind installation checks
- Non-return valve internals installation checks
- Thermal refractory lining installation checks
- Mechanical interlock checks
- Fitting of all locks on valves
- Packing of a distillation or scrubbing column
- Packing a reactor with catalyst
- Installation of filter medium and cartridges
- Air blowing
- Steam blowing
- Water flushing
- Chemical cleaning
- Tightness test
- Cooling water passivation
- Mechanical test run of pumps

NOTE: All slip blinds or spectacle plates utilized must be given a suitable tail or handle so immediate identification can be made in the field.

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Pre-Commissioning Sequence (Example) ③

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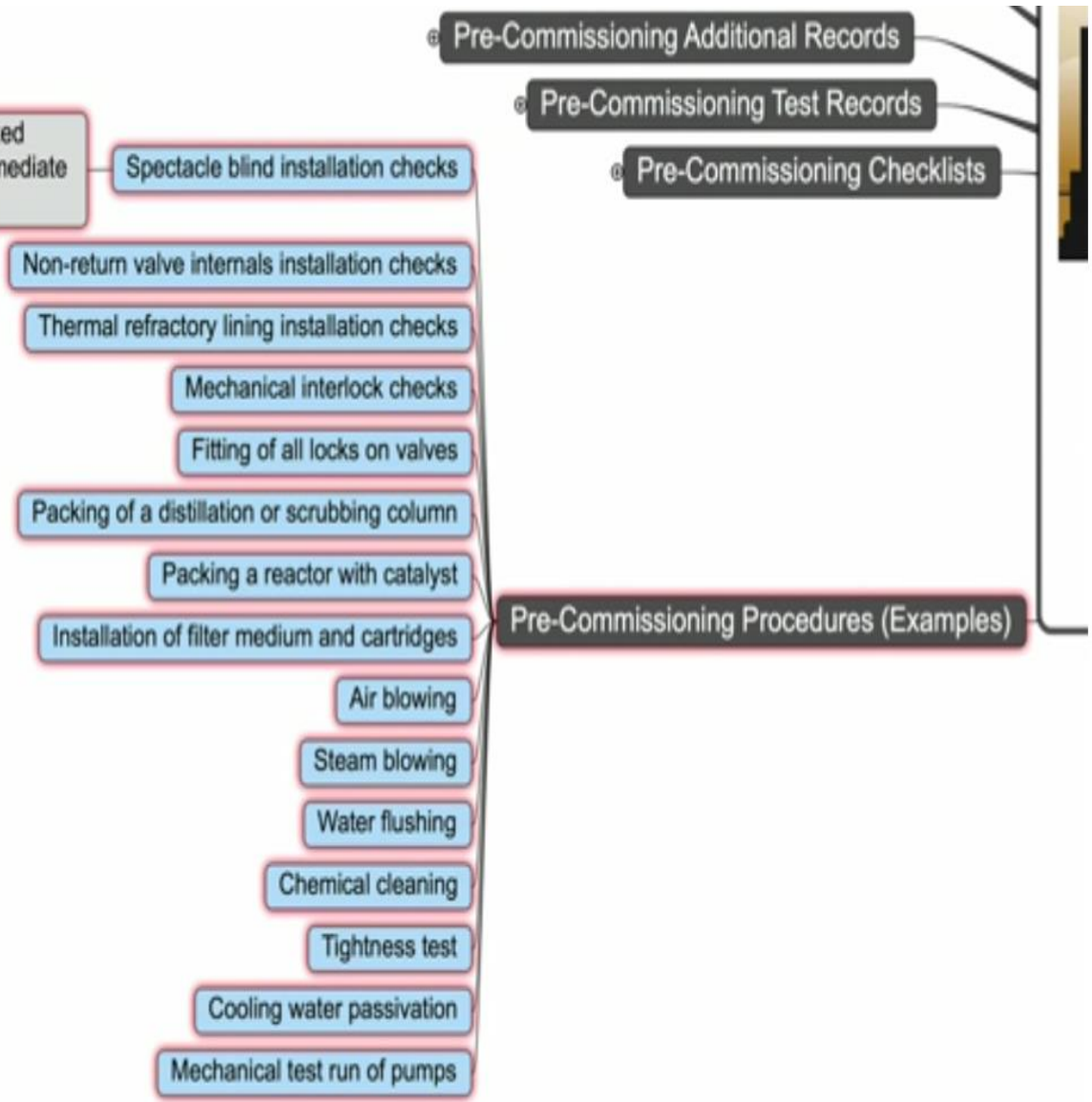
Vendor and factory acceptance testing

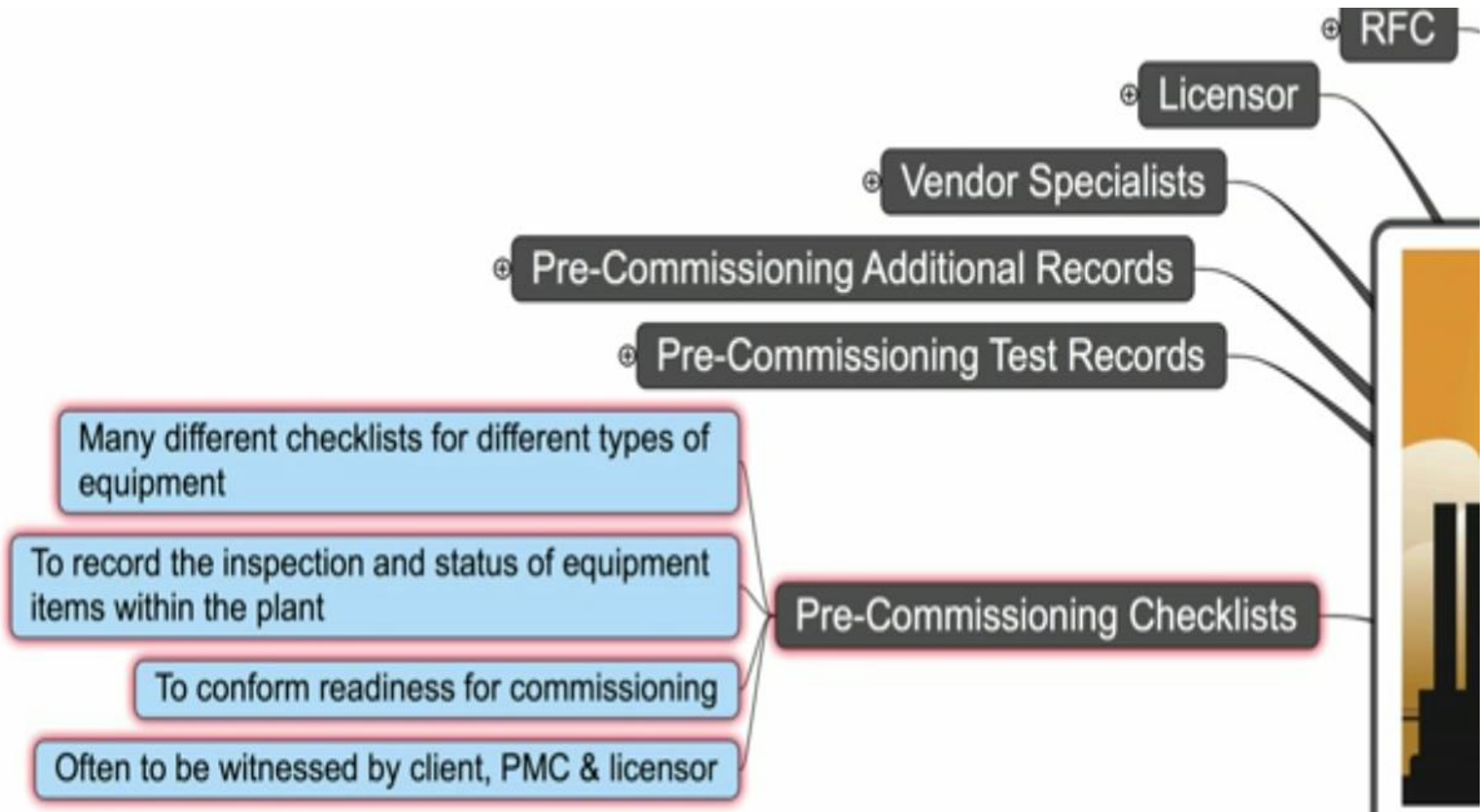
Instrument, electrical and motor loop testing

Pre-Commissioning Sequence (Example)

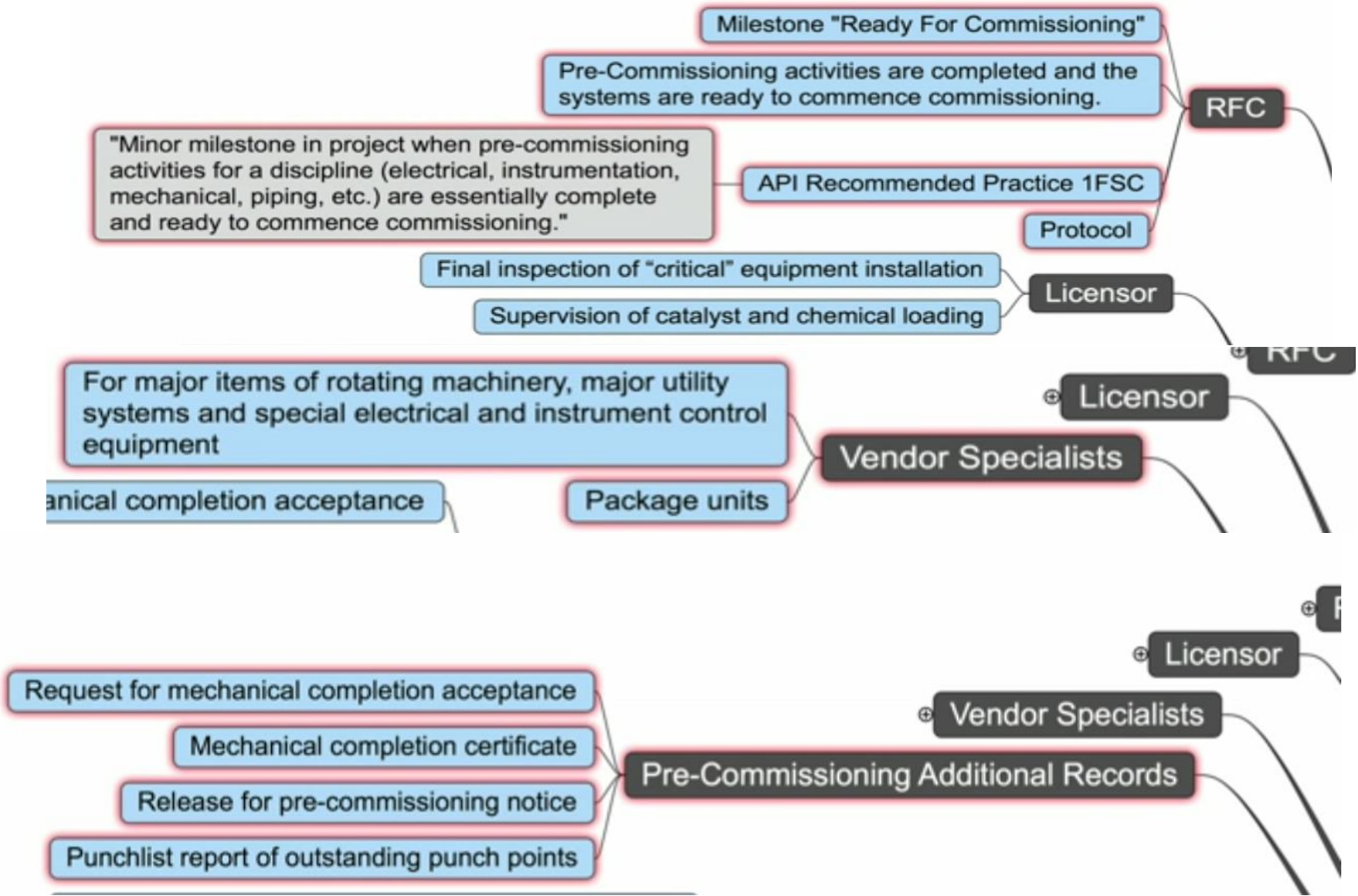
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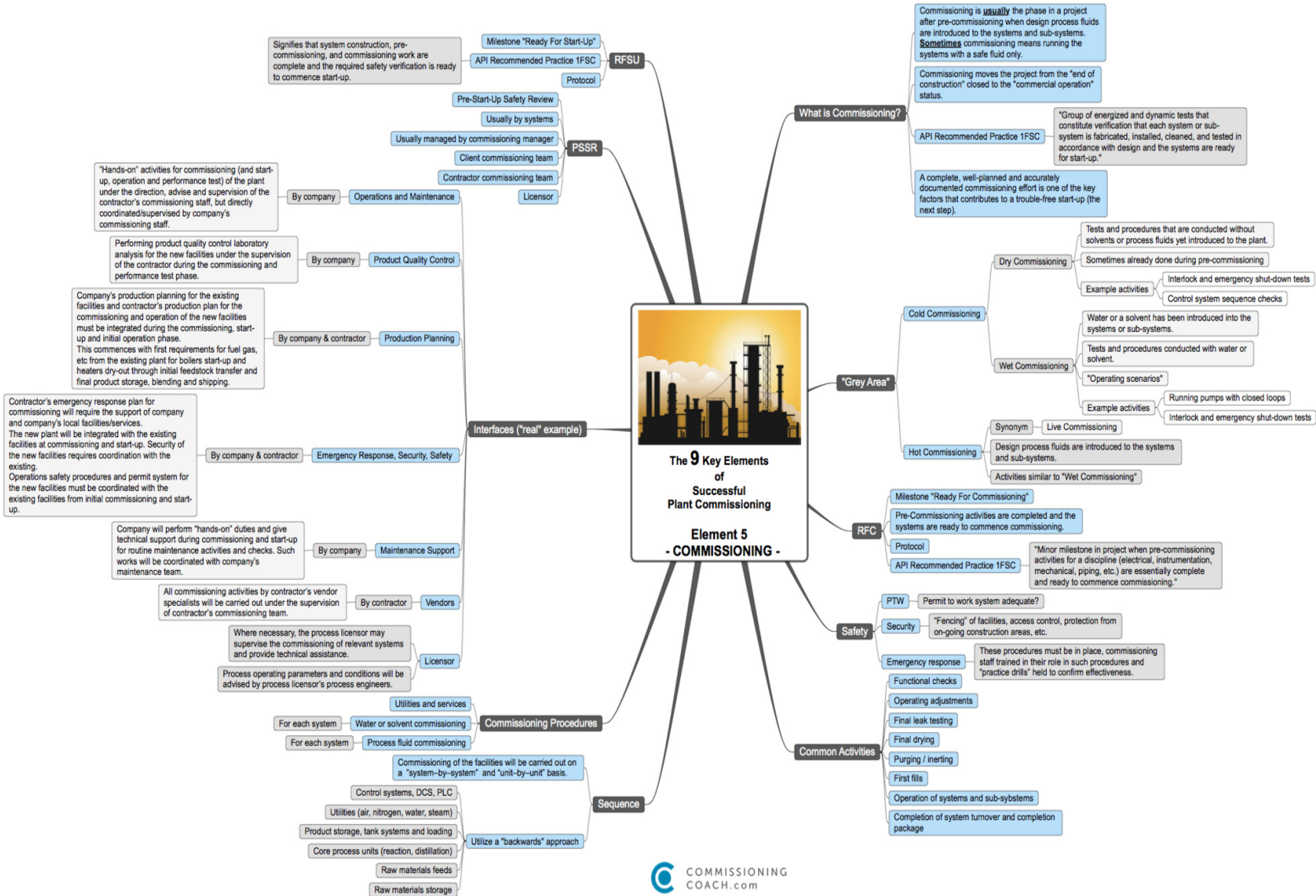
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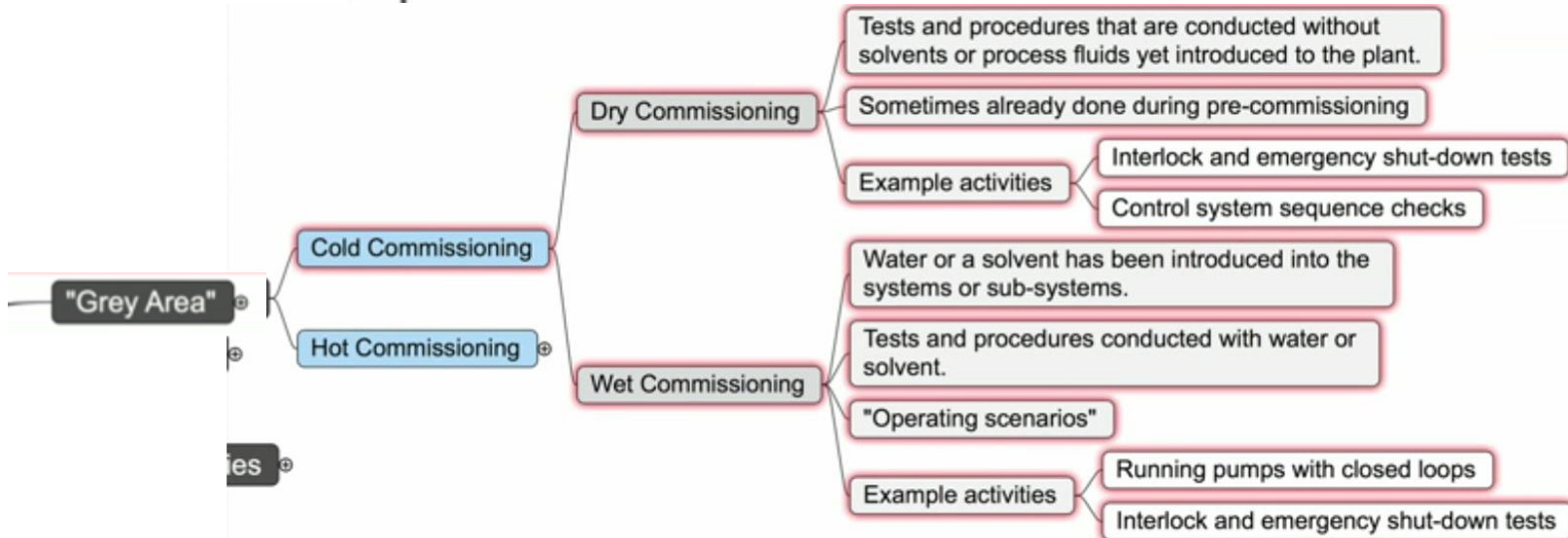
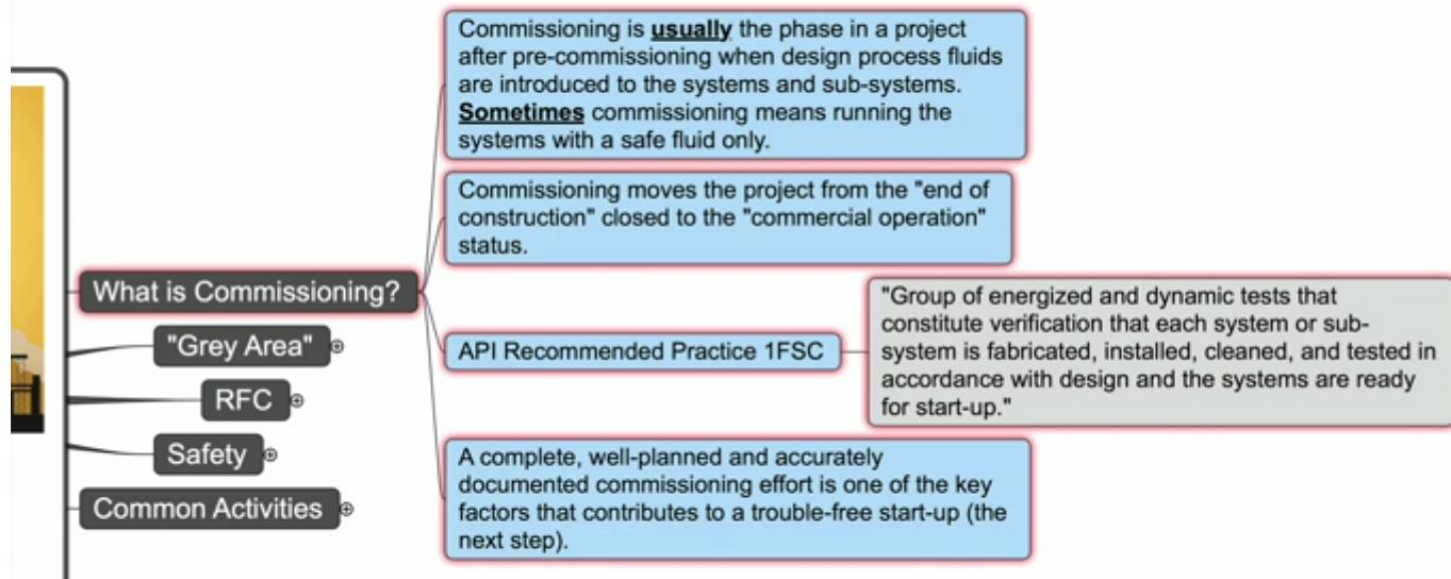


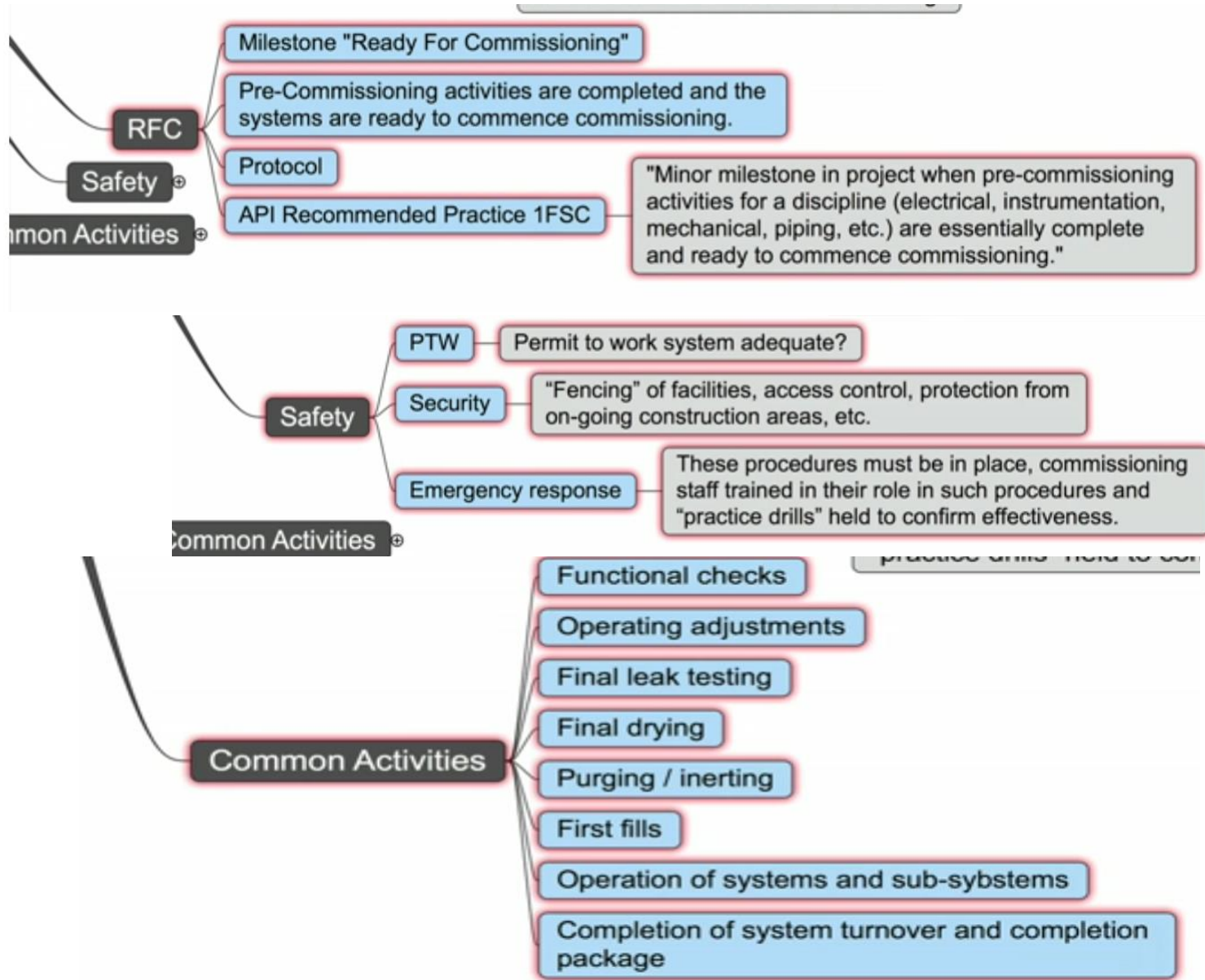


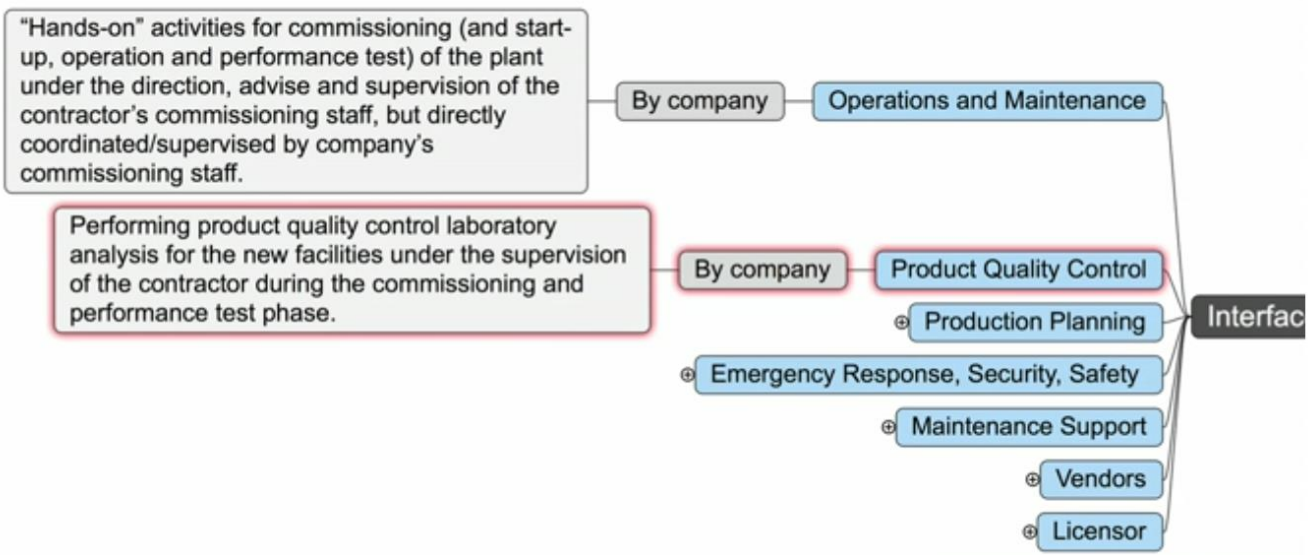
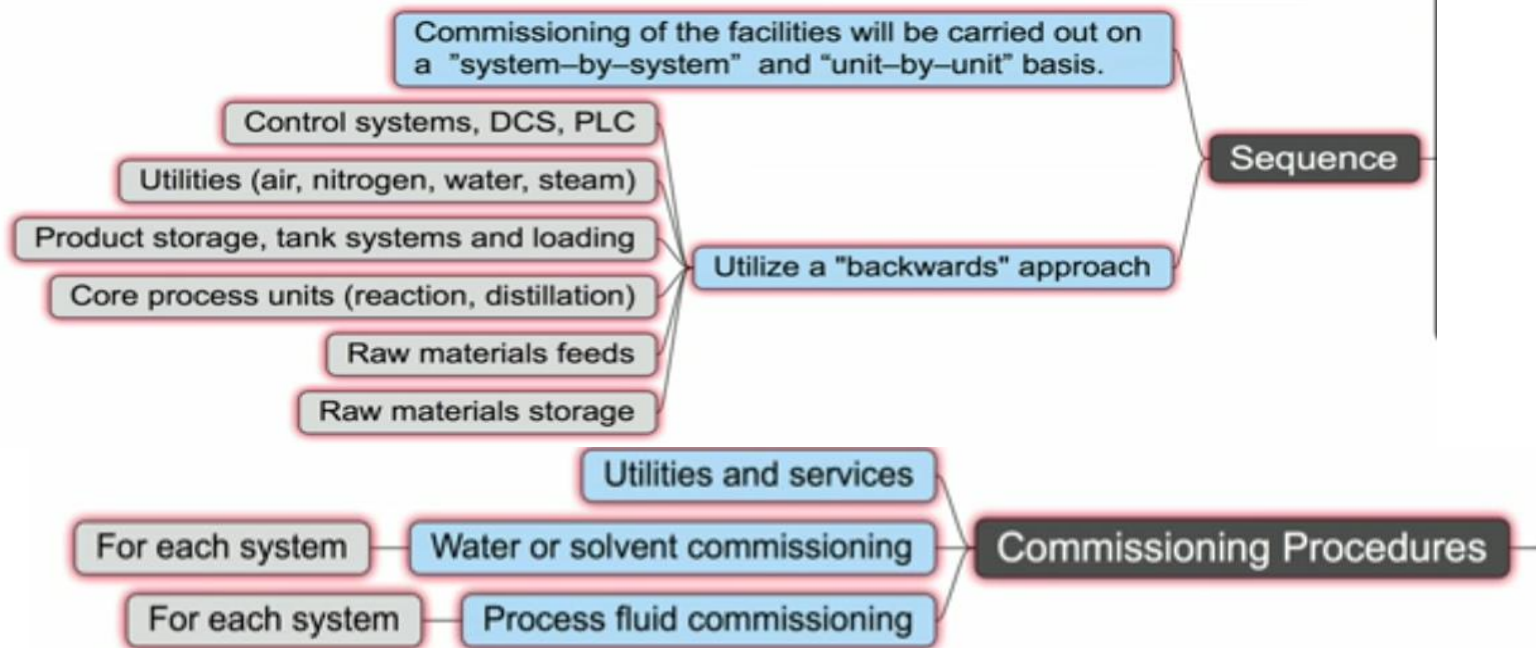












Company's production planning for the existing facilities and contractor's production plan for the commissioning and operation of the new facilities must be integrated during the commissioning, start-up and initial operation phase. This commences with first requirements for fuel gas, etc from the existing plant for boilers start-up and heaters dry-out through initial feedstock transfer and final product storage, blending and shipping.

By company & contractor

Production Planning

Company will perform "hands-on" duties and give technical support during commissioning and start-up for routine maintenance activities and checks. Such works will be coordinated with company's maintenance team.

By company

Maintenance Support

All commissioning activities by contractor's vendor specialists will be carried out under the supervision of contractor's commissioning team.

By contractor

Vendors

Where necessary, the process licensor may supervise the commissioning of relevant systems and provide technical assistance.

Process operating parameters and conditions will be advised by process licensor's process engineers.

Licensor

Signifies that system construction, pre-commissioning, and commissioning work are complete and the required safety verification is ready to commence start-up.

Milestone "Ready For Start-Up"

API Recommended Practice 1FSC

Protocol

RFSU

Pre-Start-Up Safety Review

Usually by systems

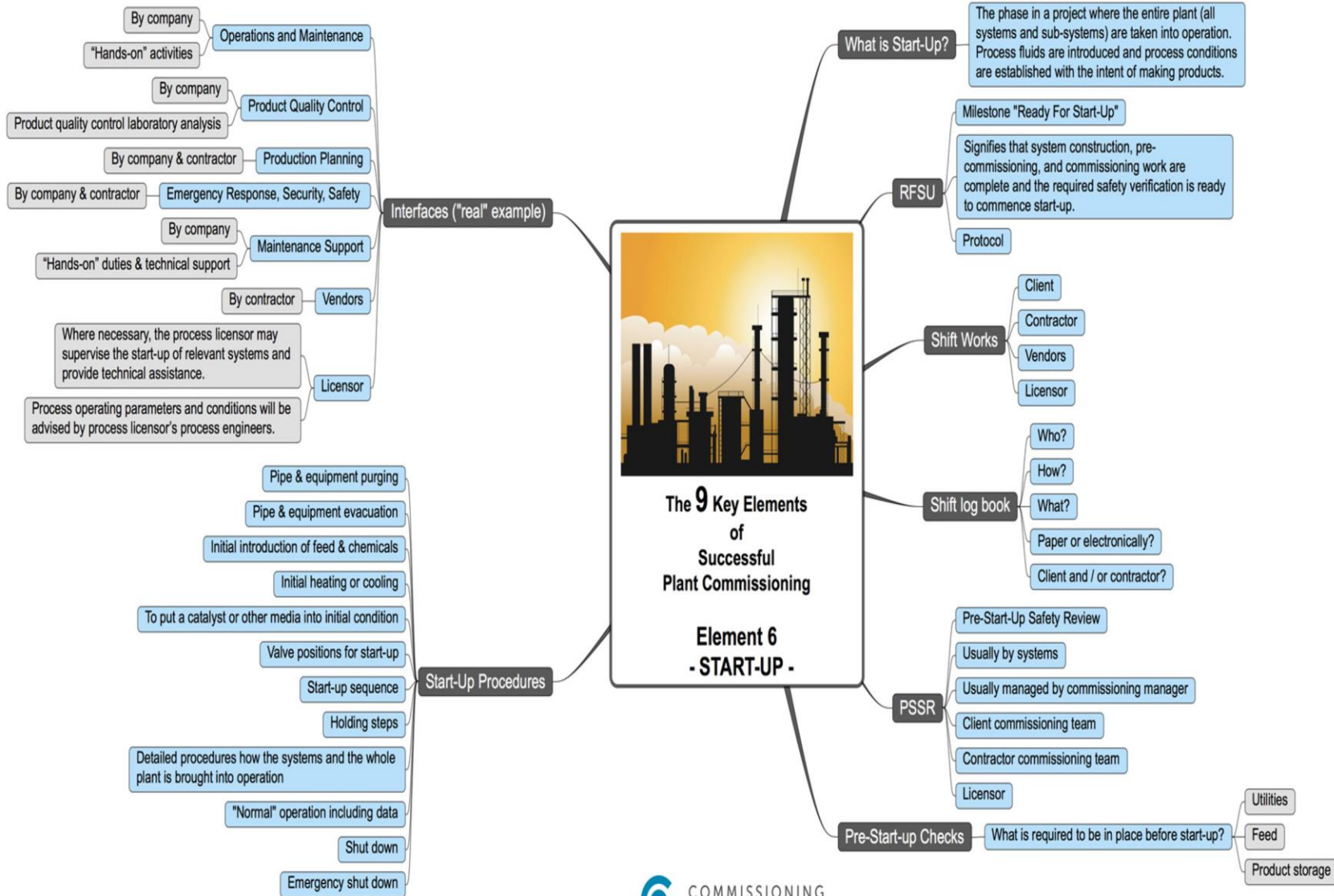
Usually managed by commissioning manager

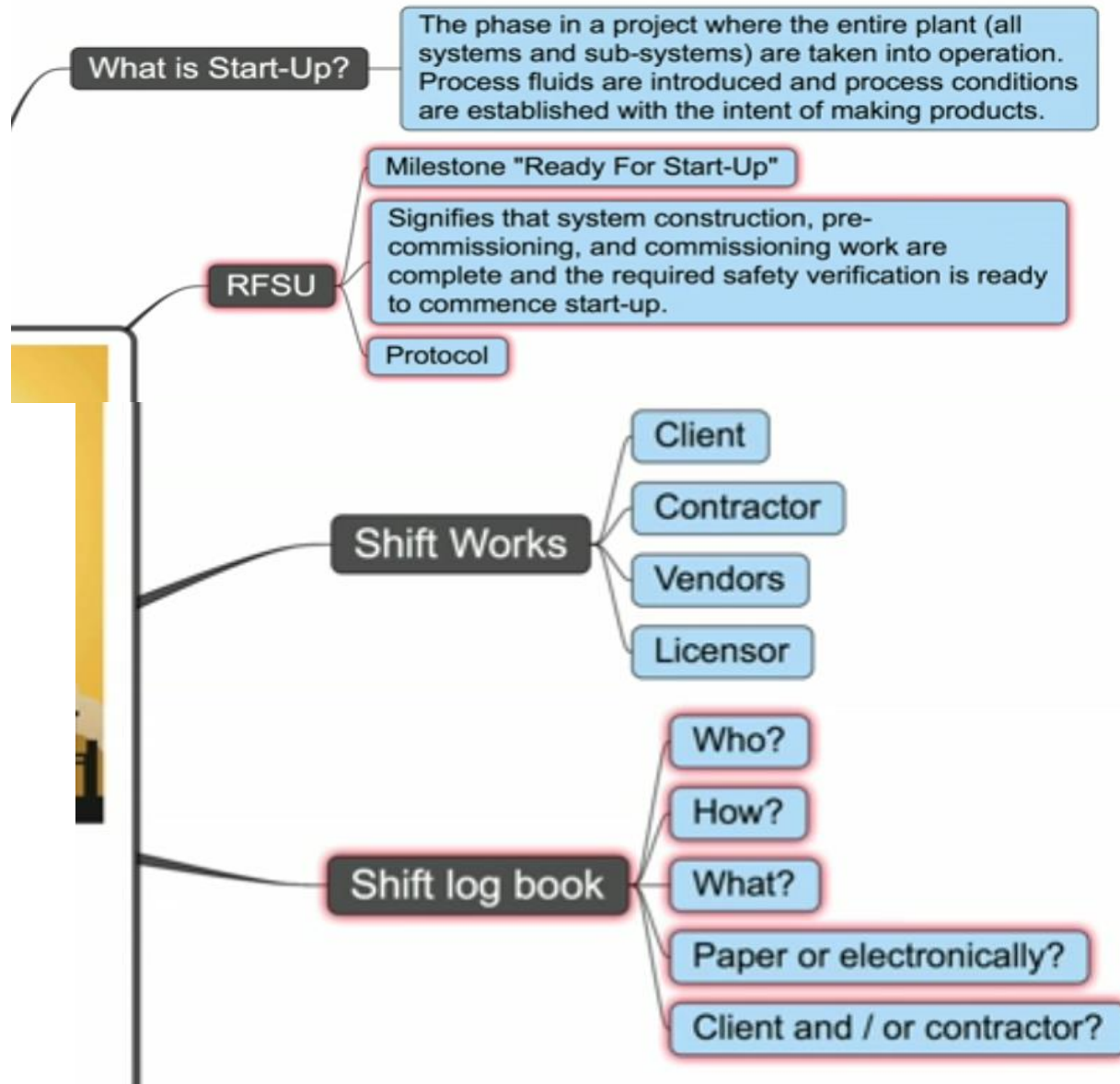
Client commissioning team

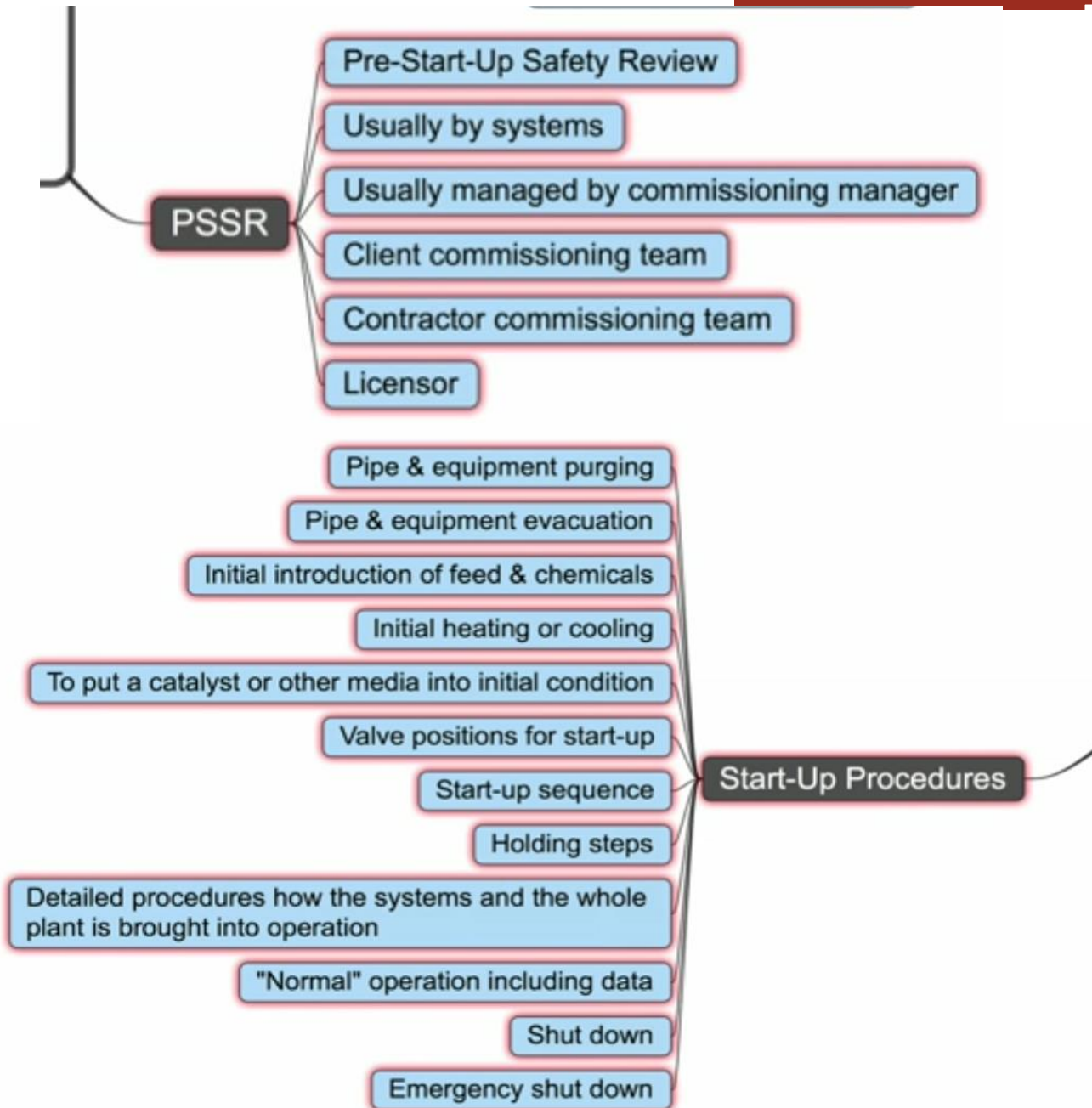
Contractor commissioning team

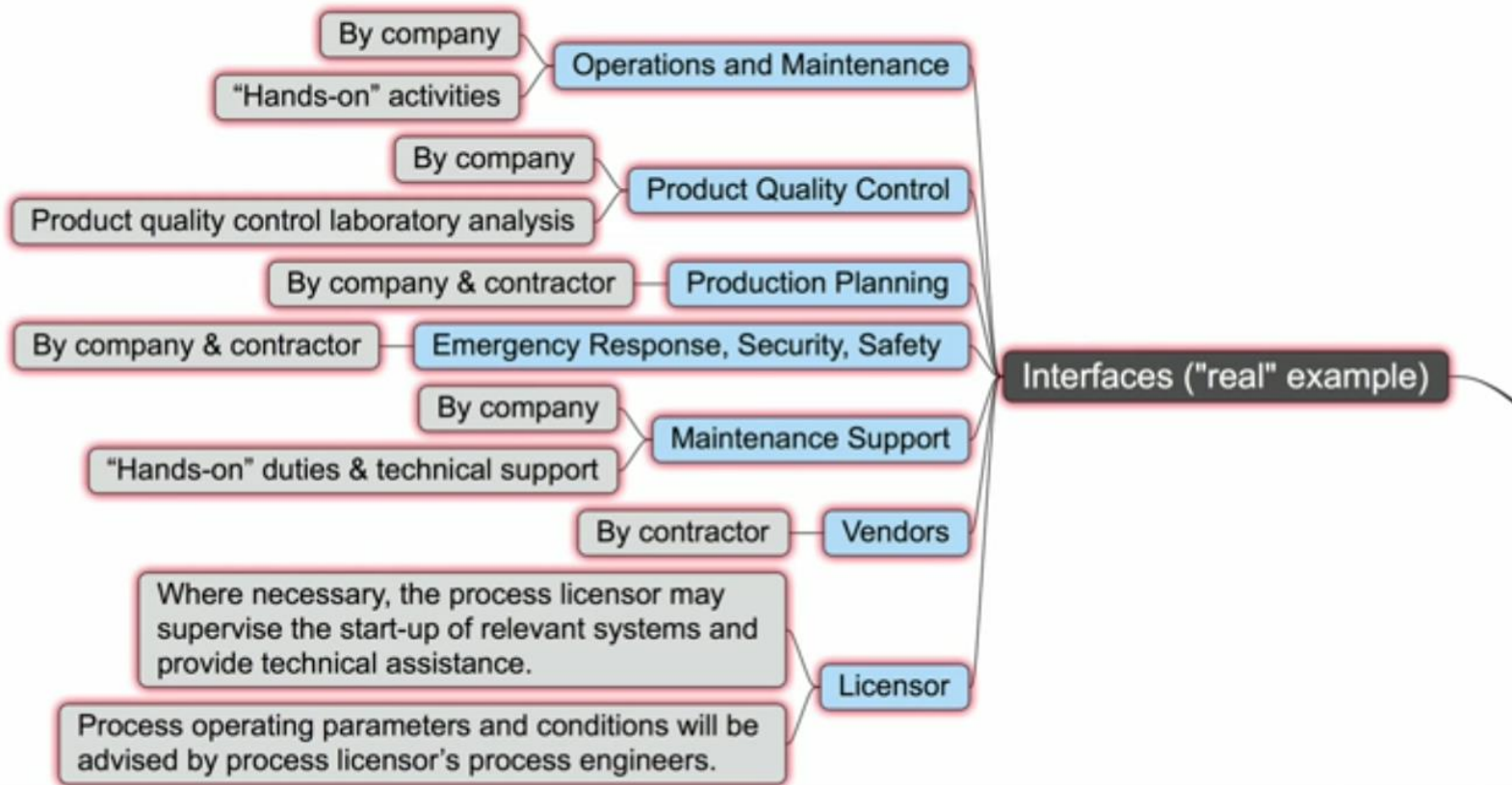
PSSR

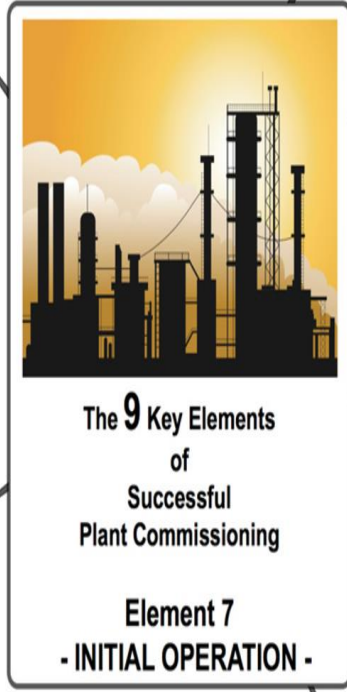
start-
nt











What is Initial Operation? The entire plant is running in continuous operation, fine-tuned and prepared for the performance test.

- Shift Works**
- Client
 - Contractor
 - Vendors
 - Licensor

- Shift log book**
- Hopefully already set-up during start-up phase ...
 - Who?
 - How?
 - What?
 - Paper or electronically?
 - Client and / or contractor?

- Activities**
- Finetuning of control loops
 - Tuning of process
 - Testing of operational limits — Emergency shut down?
 - Preparation of performance test
 - Data collection
 - Equipment data
 - Process data
 - Performance data

Next Step

Mutual agreement between client, contractor and licensor

Performance Testing

Interfaces ("real" example)

- Operations and Maintenance
 - By company
 - "Hands-on" activities
- Product Quality Control
 - By company
 - Product quality control laboratory analysis
- Production Planning
 - By company & contractor
- Emergency Response, Security, Safety
 - By company & contractor
- Maintenance Support
 - By company
 - "Hands-on" duties & technical support
- Vendors
 - By contractor
- Licensor
 - Where necessary, the process licensor may supervise the start-up of relevant systems and provide technical assistance.
 - Process operating parameters and conditions will be advised by process licensor's process engineers.



What is Initial Operation?

The entire plant is running in continuous operation, fine-tuned and prepared for the performance test.

Shift Works

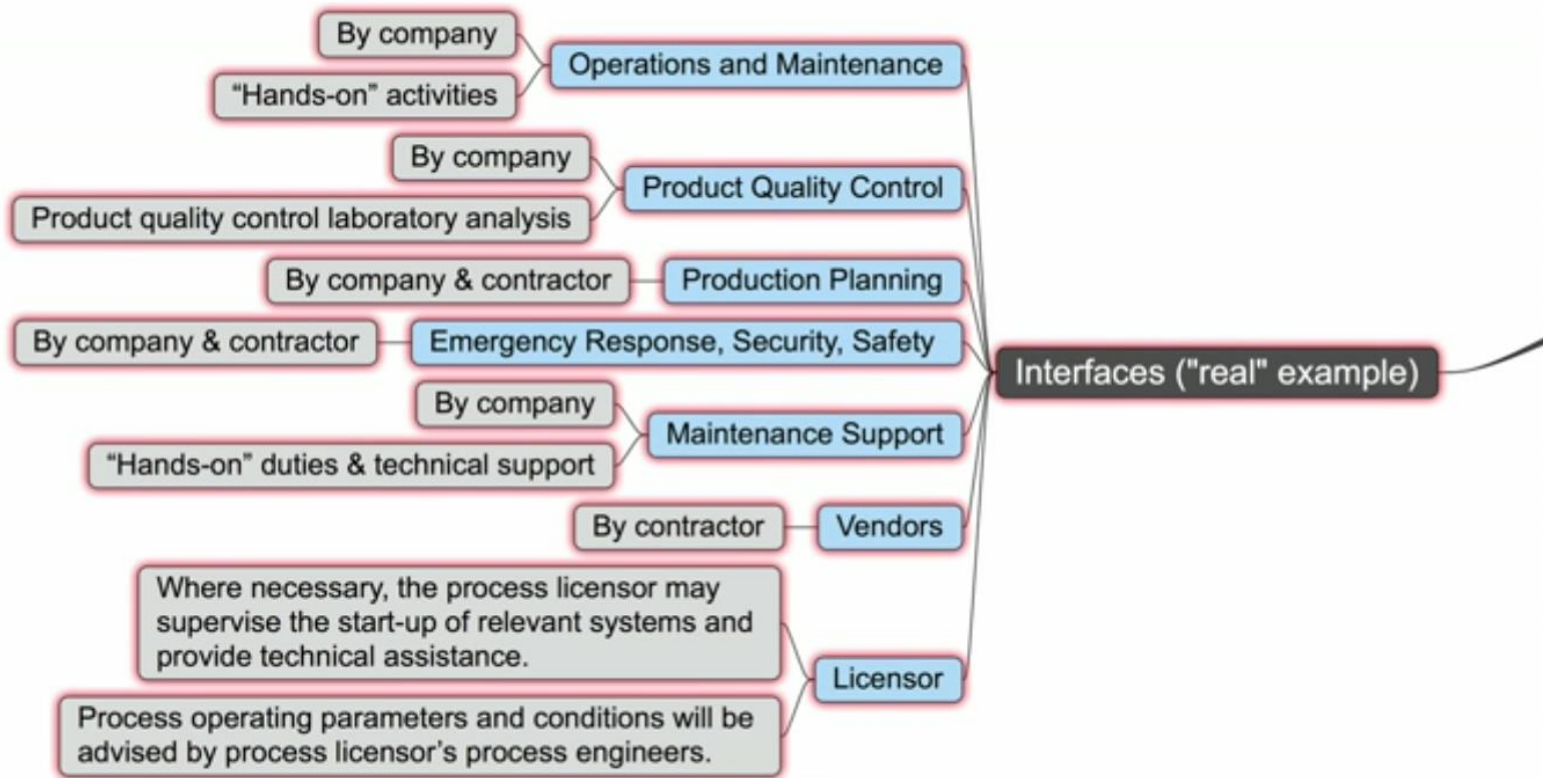
- Client
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Shift log book

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- Who?
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Activities

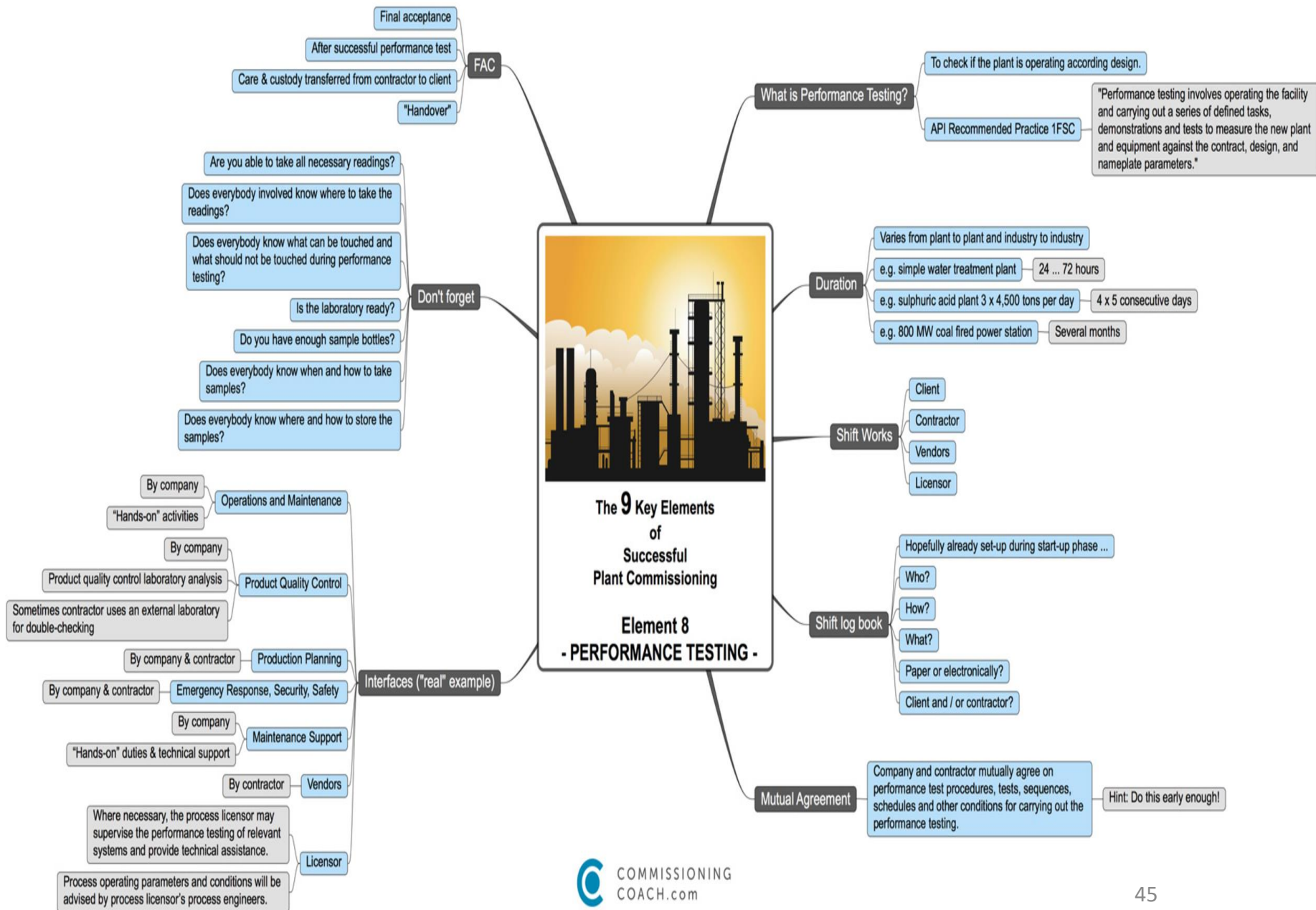
- Finetuning of control loops
- Tuning of process
- Testing of operational limits — Emergency shut down?
- Preperation of performance test
- Data collection
 - Equipment data
 - Process data
 - Performance data



Mutual agreement between client, contractor and licensor

Performance Testing

Next Step



What is Performance Testing?

To check if the plant is operating according design.

API Recommended Practice 1FSC

"Performance testing involves operating the facility and carrying out a series of defined tasks, demonstrations and tests to measure the new plant and equipment against the contract, design, and nameplate parameters."

Duration

Varies from plant to plant and industry to industry

e.g. simple water treatment plant

24 ... 72 hours

e.g. sulphuric acid plant 3 x 4,500 tons per day

4 x 5 consecutive days

e.g. 800 MW coal fired power station

Several months

Shift Works

Client

Contractor

Vendors

Licensor

Shift log book

Hopefully already set-up during start-up phase ...

Who?

How?

What?

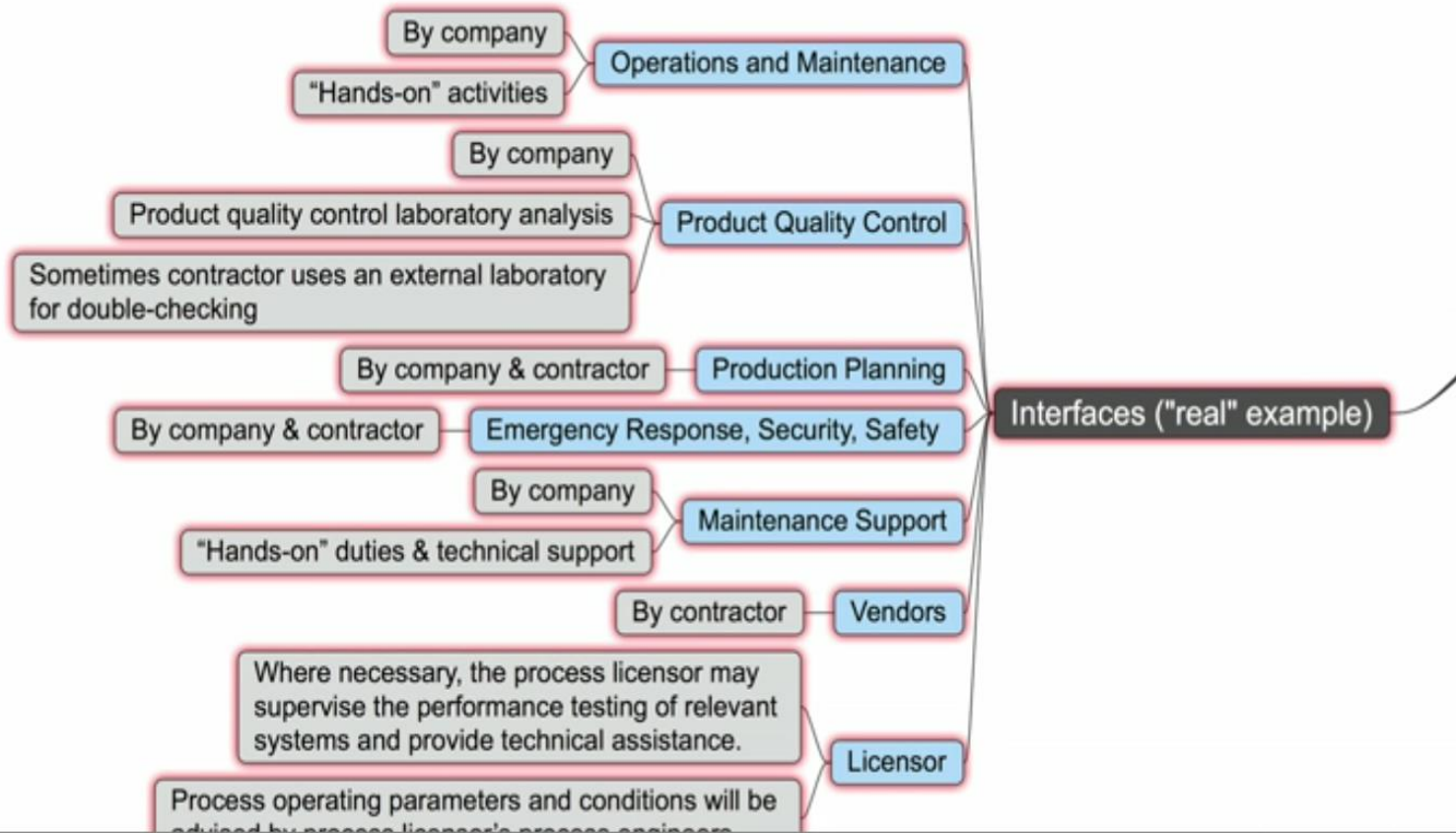
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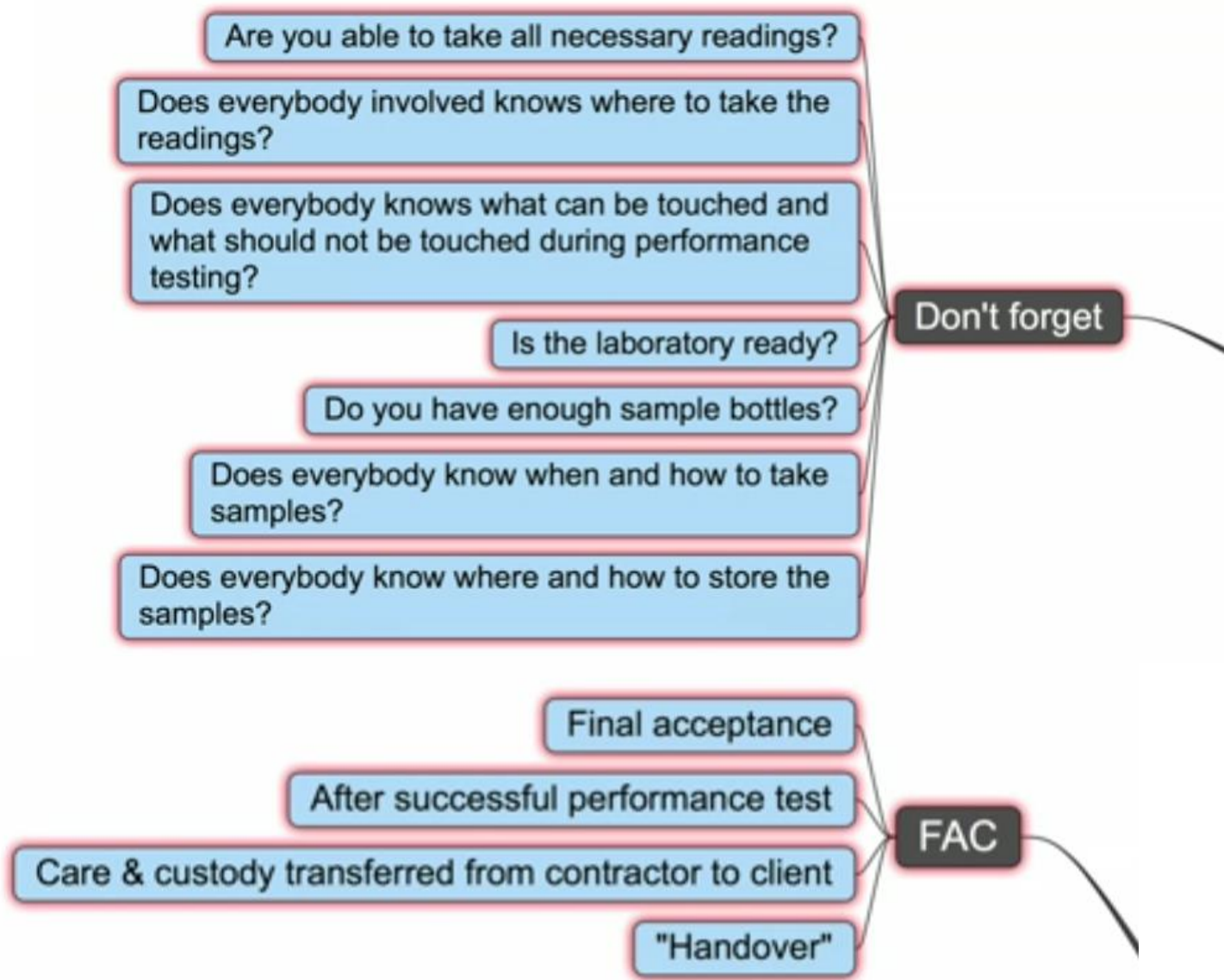
Client and / or contractor?

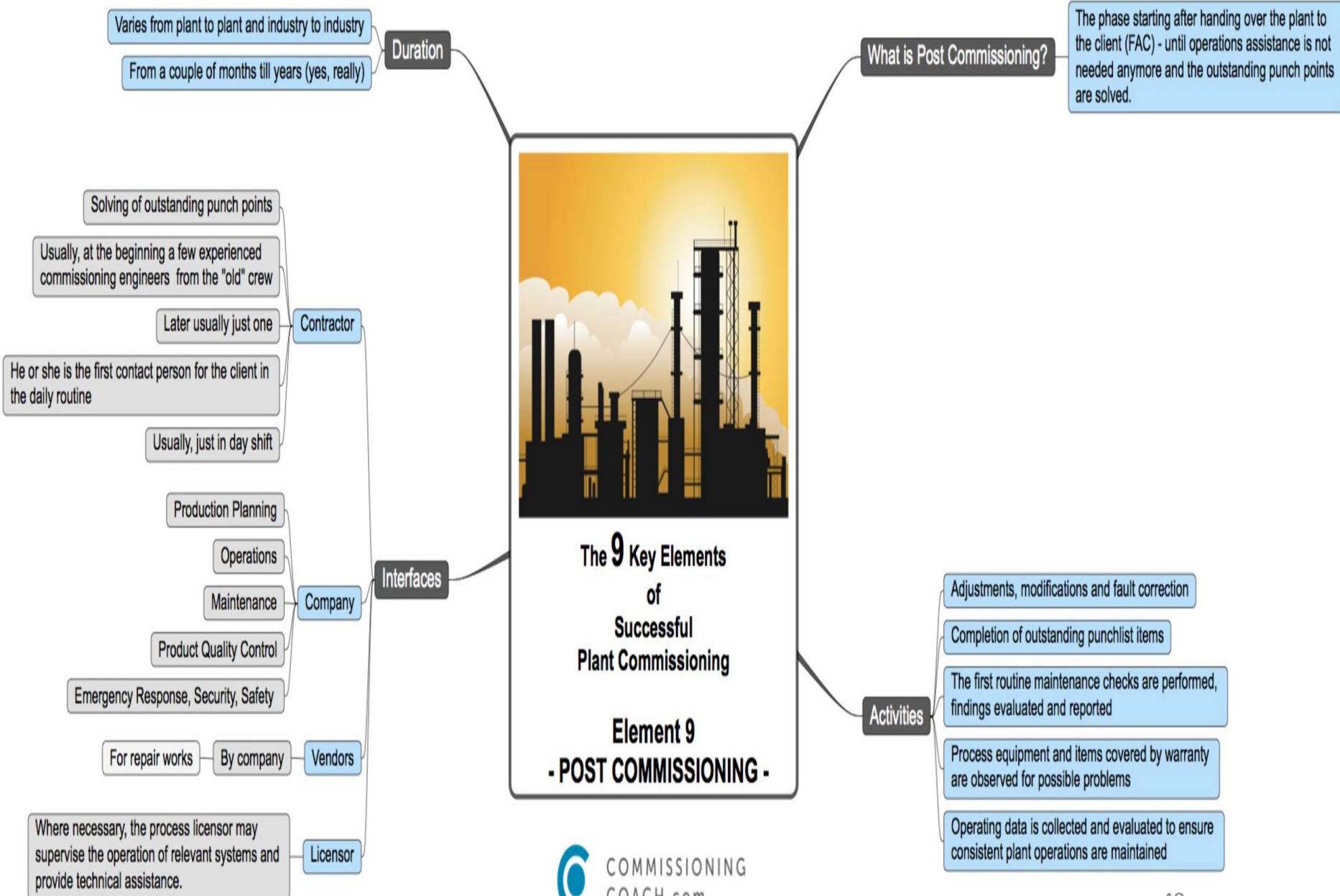
Mutual Agreement

Company and contractor mutually agree on performance test procedures, tests, sequences, schedules and other conditions for carrying out the performance testing.

Hint: Do this early enough!







What is Post Commissioning?

The phase starting after handing over the plant to the client (FAC) - until operations assistance is not needed anymore and the outstanding punch points are solved.

Activities

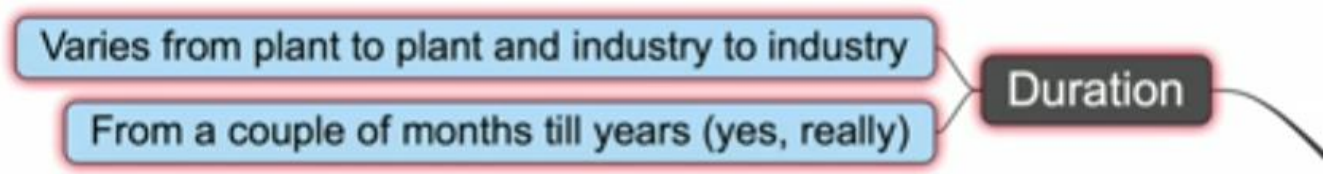
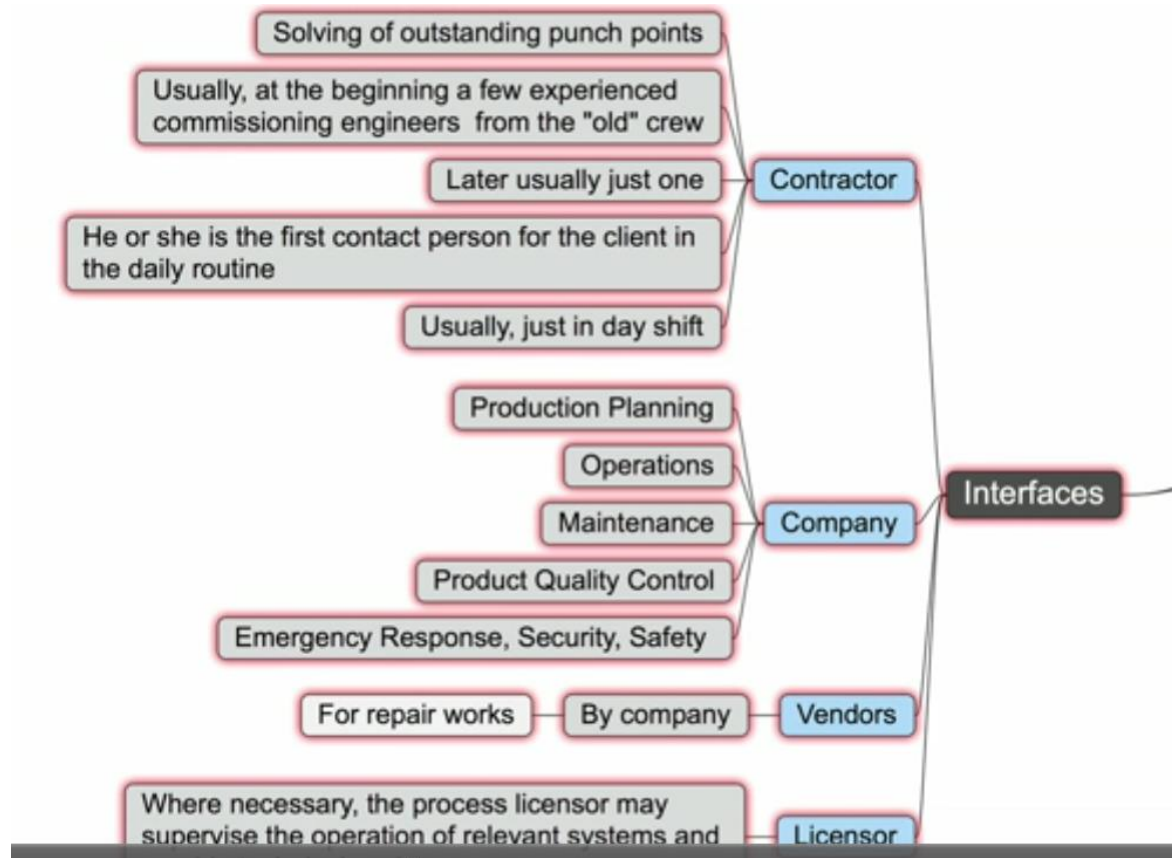
Adjustments, modifications and fault correction

Completion of outstanding punchlist items

The first routine maintenance checks are performed, findings evaluated and reported

Process equipment and items covered by warranty are observed for possible problems

Operating data is collected and evaluated to ensure consistent plant operations are maintained



Typical Mechanical Completion Activities

Mechanical completion activities includes checking of fabrication and installation work.

Executor shall complete packages related to listed disciplines and as required by the MCSI.

Executor shall complete the check list items as per the MCCR's. The activities shall include but not be limited to:

Mechanical

- Visual inspection for complete and correct installation.
- Internal inspection of tanks and vessels.
- Alignment.
- Load testing of lifting equipment.
- Hot oil flushing.
- Bolt tensioning.
- Dimension control.
- Preservation.

Piping

- NDE carried out.
- Welding procedures.
- Removal of all items subject to damage during flushing, cleaning and pressure testing.
- Flushing of pipework.
- Chemical cleaning and testing of pipework.
- Drying of tested pipework.
- Preservation of tested pipework.
- Reinstatement of all items after testing.
- Final inspection of pipework.
- Test ISO's and P&ID's showing the extent of each pressure test.
- Pneumatic and hydraulic tubing.
- Hot oil flushing of pipework.
- Bolt tensioning.
- Pipe supports completed.
- Insulation.
- Flow coding.

MECHANICAL COMPLETION DOCUMENTATION

Documentation for a MC package

MC certificate (MCC)

Piping completion status

MC check record - Instrument installation and inspection

MC check record - Electrical motors

MC check record - Centrifugal / screw pump, compressor and motor

Punch list

MC documentation for a Commissioning package

Ready for commissioning certificate (RFCC)

1.11 Tanks – Account M

a.	Clean out debris, etc.	X	
b.	Carry out chemical cleaning as required by job specifications	XX	
c.	Cure and dry out any special cement or protective linings in accordance with manufacturers' specifications and instructions		X
d.	Test in accordance with applicable specs	X	
e.	Purge systems and charge chemicals as required	XX	
f.	Calibration of product tanks		X

1.12 Shell and Tube exchangers – Account T

a.	If desired, field inspect exchangers which have been shop inspected		X
b.	If desired, field test exchangers which have been subjected to a shop test		X

Thank You