Technical Article

Stage- gate Process and Criticality of Front End Loading

Modern day chemical projects are becoming more complex and with the competitive market it is very essential that each project gets completed with the three key parameters of Quality, Schedule and Cost under control. It is very common to hear of projects getting delayed and going over budget.

Introduction to Stage Gate approach

To streamline the execution of projects, one of the most effective tools is the implementation of the Stage Gate process while executing projects. This methodology involves dividing the project into multiple stages and having a check (GATE) at the completion of each stage. This enables the management to gauge whether the project is on track and also provides them with opportunities to decide whether to proceed and release further funds to the project or to discontinue the project.

A typical project is always split into 5 distinct stages and corresponding 4 gates as can be seen in the figure 1 below.

The main idea of the Stage Gate Process is that the Project team has to go to the management at the completion of each stage and get an approval from them to move ahead to the next stage. So each gate acts as a checkpoint for the project wherein all Key stakeholders in the form of a Steering committee or company board are involved in the decision making process.

FEL or Front End Loading is a standard defined by IPA (Independent Project Analysis) for the initial phases of the project.

The first three gates are very critical as it is only at the third gate FEL3 the main project funding is approved by the management and the actual purchase of hardware like equipment, piping, instruments etc is done only after FEL3. So, not only does the first three stages give an opportunity to scrap the project if not found feasible but also any item missed out at this stage will get amplified in terms of cost and schedule impact.

To understand the importance of the FEL3 gate, 80 per cent of the project finances are allocated at this gate. So, the accuracy of the FEL3 package can make or break the project.

FEL2 and FEL3 Content

FEL1 is normally applicable for New product application i.e. if a new product has been implemented in R&D and needs to be scaled up or if a new process is developed for an existing product. In this article we shall focus on the implementation of project for existing product for which the basic commercial scale feasibility is established.

In such a case the FEL2 and FEL3 stages become most critical. The primary check to be done is to ensure that all relevant information/ documents required for clearing the gate are available. Given below is a summary of the documents required on the completion of FEL2 and FEL 3 stages to clear the respective gates.

While going in for the management clearance for the FEL2 or FEL3 gate it is always advisable that check list with complete list of documents be always used. The documents which are not relevant for a specific project should be accordingly indicated in the list so that it is ensured that no aspects of the project are missed out.

In addition to the documentation requirements it is essential that certain cross-functional reviews are conducted in these stages.

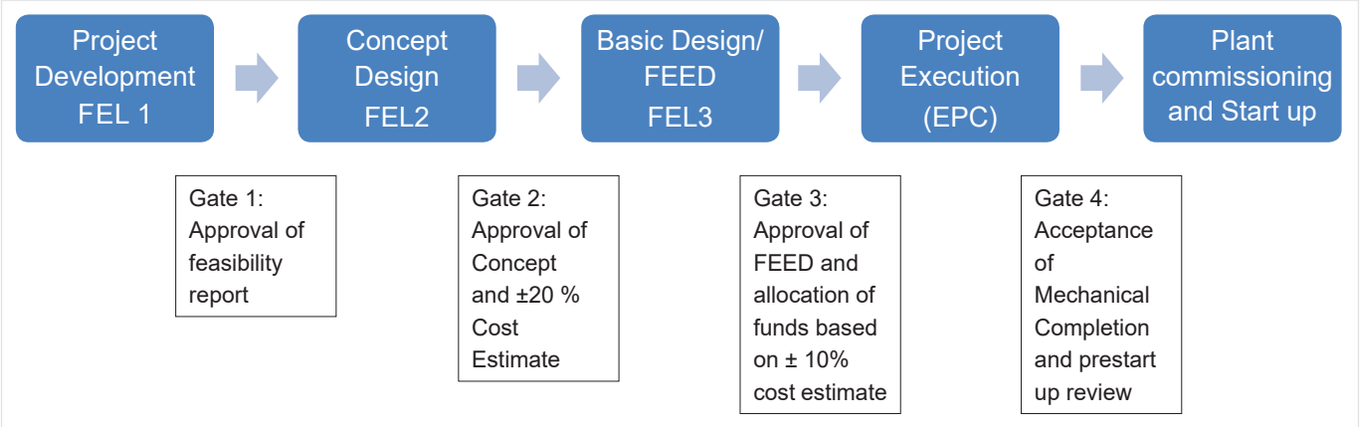

Figure 1: A typical project is always split into 5 distinct stages and corresponding 4 gates

Stage	Discipline	Document
Concept Design	Process Engineering	Project description, Preliminary process flow diagrams, Equipment list and load list, Control Philosophy
	Project Engineering	Organisation chart, Execution strategy, Cost Estimate ± 20% preliminary estimation of ROI
	Layout	Plant layout, logistic concept
	Civil and Structural	Site master plan, Soil Investigation studies, Building/ Structure outline drawings
Basic Design	Process Engineering	Specifications and Standards, P&ID`s (AFD) for process and utility, Tie-In drawing, Equipment datasheet (for purchase) Laboratory description
	Project Engineering	Cost estimation +/-10%, Time Schedule
	Instrumentation	Instrument specifications (DCS, PLC, Control Valves,), Control loop list
	Civil and Structural	Architectural guide drawings, Steel structure calculations
	Layout	Preliminary model(3D model or 2D drawings)
	Electrical and HVAC	HVAC Design, Electrical guide drawings for lighting, power systems, substation arrangement, IT and Telecom equipment
	General	First MTO`s for Piping, Civil, Electrical and Instrumentation, etc

Table 1: Documents required on the completion of FEL2 and FEL 3 stages to clear the respective gates

For the FEL2 stage, the required review is an HAZID study which identifies the major hazards in the plant and identifies means to handle the hazards.

For FEL3 stage, it is essential that a HAZOP study and Constructability study be completed before the Gate.

For the HAZOP study all information especially vendor specific details might not be available, but at a minimum the extent of Instrumentation and Controls provided and the requirements of Safety Instrumented systems need to be evaluated. These have a major impact on cost and also on timelines due extended delivery dates for imported instruments.

Constructability review might throw up a major change in layout to ensure smooth installation of equipment and also additional area requirements for laydown and equipment installation.

Authority Approvals

In addition to the above documents it is very critical that all the authority approvals required for the project be identified and a timeline for the same be prepared. Since local authority approvals are mandatory for the project, delays in getting them are a major cause of project delays and also can lead to project getting scrapped after proceeding ahead in the Execution i.e. EPC phase.

Criticality in Project

The implementation of the stage gate process is considered by some to be a tedious and time consuming process which leads to extended project timelines, but the reality is far from this. Implementing the Stage Gate process has its clear benefits:

- **Clarity of Project scope:** With the detailing that is required and using check lists for the documentation, there is a clear understanding of the inclusions and exclusions in the project.

- **Traceability:** Any modifications done to the project scope can be easily identified and the corresponding impact on Schedule and Cost can be easily estimated and tracked.

- **Buying from key Stakeholders:** Since the procedure requires passing through the Gate process at the end of each stage, it ensures that all key stakeholders are kept aware of the status of the project and there is a clear agreement between the project team and the key stakeholders on various assumptions and deviations.

- **Judicious Use of Resources:** With the use of the stage wise approach only limited spending of money and allocation of people resources is done in the initial stages with sufficient to limit the damages in case the project is found unviable at FEL2 or FEL3 stages.

Checks to Supplement the Stage-Gate Process

So, does it mean that a simple implementation of the Stage Gate method would lead to projects getting completed on time and within cost?

Unfortunately that is not the case. Even after using the Stage Gate method there are cost and time overruns primarily due to 4 factors:

- Projects are overdesigned/ over engineered
- Unsubstantiated contingencies are considered
- Project is prone to risks which are not anticipated
- Improper Contractor selection

To combat this it is essential that two tools i.e. Class of Facility Analysis and project risk register be used along with the Gate Process.

- **Class of Facility analysis:** This enables the project team what is most

critical to management for the specific project. The analysis is done by a Cross functional team who rate the project on nine factors on a predetermined scale which includes Capacity, Product Quality, Reliability, Expandability, Lifetime, Automation, Maintainability, Turnaround and Schedule.

If we take the example of a Pharma project the rating of Product Quality and Capacity would come highest whereas items like Turnaround and Automation would be pretty low priority.

A clear rating from the assessing team gives a direction to the Project team while designing the project and ensures that the design is always aligned to the Management requirements.

- **Project Risk Register:** The project risk assessment has to be started right from the FEL2 stage and has to be continuously updated throughout the project. Having a clearly documented Project risk register enables to provide for adequate contingencies in cost and timeline. Also the risks are continuously monitored and more importantly appropriate project team member can be assigned handle individual risks and the effects of the same can be mitigated.

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- **Contractor Evaluation:** The approach taken by a lot of project teams is of one contractor fits all which is detrimental to the project. For effective execution the contractor evaluation has to be done based on the size, complexity and in some cases location of the project.

Conclusion

A combination of the Stage-Gate Process with the three add-on points would go a long way in implementing successful projects which would meet all three Key Success Factors of Quality, Cost and Schedule. ■

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