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How to easily estimate the duration of an Oil & Gas EPC Project

by Hervé Baron

Did you know that Oil&Gas facilities projects have all the same critical path? Well, if you think about it, you will easily realize that what takes the most time in their completion is their piping. Thanks to a number of rule-of-thumb estimates that can be added to this observation, it is easy to deduct what is the duration of an EPC project in the Oil & Gas field, and what are the parameters that actually drive this duration. In this unique groundbreaking paper, Hervé Baron reveals key fundamentals that will be useful to any Project Manager in Oil & Gas EPC projects.

Capital Projects have become so big and complex nowadays that it is easy to lose sight of what drives their duration. This papers aims at recalling such fundamentals, and push further to deduct key rules for estimating project durations.

What takes the most time in the completion of most projects is the piping. Think about how many welds are involved and how much time each weld takes, not to mention all what follows: Non Destructive Examination, heat treatment when applicable, supports, painting, insulation, hydrotest.

What drives the piping work duration?

Piping is indeed by far the most time consuming activity at the job Site. Let's look at all the activities coming into pipe works:

- Piping comes in small individual items: straight lengths, 6 or 12 meter long, elbows, flanges, o-lets etc. They have to be welded together at the job Site.
- Piping is prefabricated to some extent to reduce construction time. Welds done in the workshop (shop welds) indeed take half the time as welds done in-situ (field welds). However only 2/3 of the welds can typically be done in the workshop.
- The time required to do a weld, even when done at the workshop, is already long enough: a full day for one welder for one weld on a 24" pipe.
- Once welding is completed, the piping pre-fabricated parts, called "spools" will be sand blasted, coated with a primer, brought to the erection location, erected and fitted-up.
- Field welds will then be carried out, followed by Non-destructive examinations and post weld heat treatment, if any.
- Supports will then have to be installed. The line will be inspected, for compliance to the drawings, and pressure tested. It is then flushed, provided a final coating, as well as tracing and insulation, if any.

All these completion works take a lot of time. In fact, contrary to mechanical equipment which are brought already fabricated and tested to Site, piping is wholly fabricated, inspected and tested at Site.
This is why pipe-work takes so much time and is the most common critical path of any facilities project.

What is the critical path made of?

This path is made of the following activities:

- pre-fabrication,
- erection,
- completion.

The start date and duration of these activities determine the overall duration of the Project.
Statistical information is usually available in Contractors' data bases which allows prediction according to historical data for similar size and type (refining/gas etc.) project.

An easy rule to determine the project's duration

The overall duration of a Project is indeed determined as follows.

First, determine the date of piping pre-fabrication

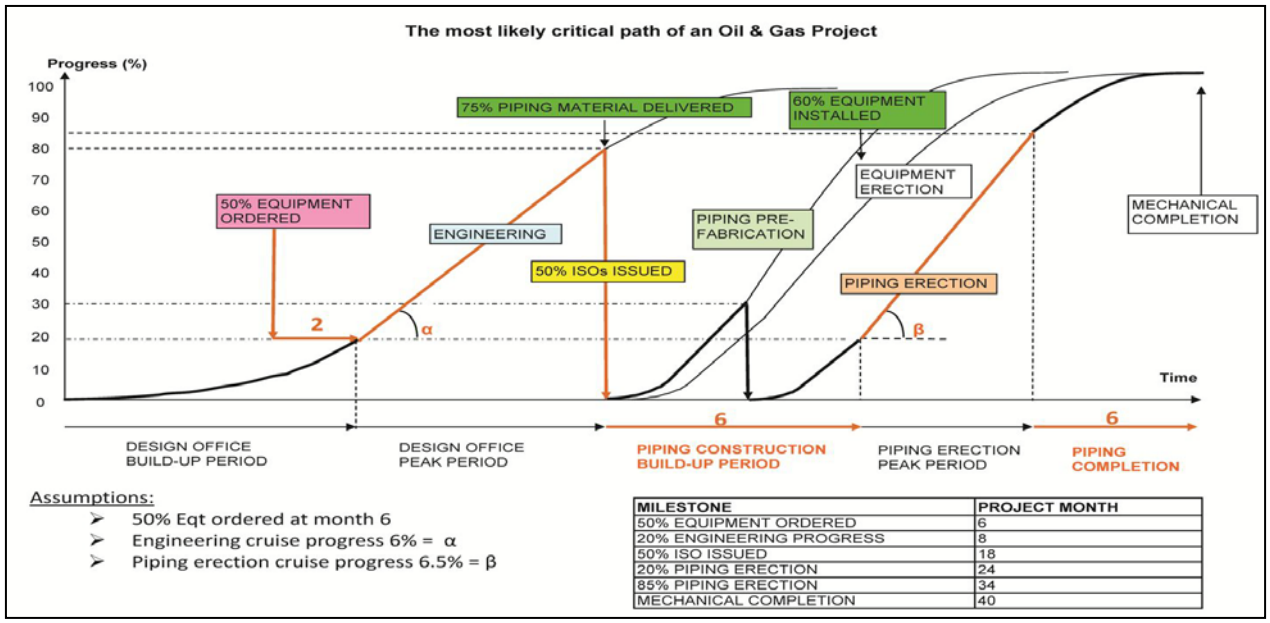
Piping pre-fabrication activities can only start once both the construction drawings have been issued and materials have been delivered to Site. In contractors' experience, for pre-fabrication to effectively start:

- 50% of the piping construction drawings (isometric drawings) must have been issued
- 75% of the materials of all types (pipes, all types of fittings, all material grades) must have been delivered to Site.

Statistics show that 50% of piping isometrics are issued when an overall engineering progress of about 80% is reached.
Engineering progress has proved to be linear from 20 to 80%, with a slope which depends on the number of manhours and ranges from 6 to 9% per month.
20% engineering progress is known to be achieved 2 months after 50% equipment have been ordered, which itself usually happens 6 months after the EPC Contract start date (provided the FEED is of good quality).
Having this in mind, one determines the 50% isometric issue date. For a large job, for instance, with a 6% engineering cruising monthly progress, 50% isometric issue can be estimated to take place at Project Month 18 (= 6 + 2 +(80-20)/6).
Note that Engineering progress is heavily dependent on Vendor information. The "50% equipment PO placed" milestone is critical. It directly determines the date (2 months later) at which Engineering will achieve its cruising progress.

Second, calculate the duration of piping erection

Experience shows that 6 months will elapse between the start of piping pre-fabrication and the time when piping erection will reach its cruising speed, corresponding to 20% progress (in other words, 20% weight of pipe-work erected).
Piping erection progress has proved to be linear from 20% to 85%.
Erection speed will reach an upper limit on every job, as it is constrained by the available space on the ground, which restricts the number of personnel and cranes. Engineering contractors have statistics which show that the monthly cruising speed depends on the type of facility (refinery, gas plant etc.) and the number of construction manhours.
The piping erection cruising speed will typically be around 6% on a large job. Let's assume it is 6.5%. Progressing from 20 to 85% will then take (85-20)/6 = 10 months.
Finally, once erection has reached the 85% progress mark, its progress will stop being linear and will become asymptotic.



Piping completion works, from 85% erection progress to mechanical completion, i.e., all pipe-work installed, supported, tested, insulated, is best modeled as a constant, typically 6 months on a large job.

Summary for the estimate of the duration of an EPC oil & gas project

The project overall duration therefore comes down to:
Piping 50% isometrics (18 months) + 6 months from start pre-fab to erection cruising + 10 months from 20 to 85% piping erection + 6 months completion = 40 months. This is indeed the typical duration of a large size EPC.
Note that the above modeling can be done both at the outset of the project, to determine its overall duration and also any time during the project to determine its remaining duration.
In the latter case, the up-to-date estimate of quantities (the 100%) and the experienced cruising speed must be used.

Sensitivities for duration estimates

The above explanation overlooks some underlying requirements that, if not met, will affect the piping path. Because the piping path is the critical path, the project must organize itself to ensure those activities effectively remain sub-critical.

Pipe material ordering

A key requirement is that in order to have 75% of piping materials delivered at site on month 18, orders for all types of piping materials will have to be placed in due time, taking into account the lead time of each type of materials (exotic materials, large diameters etc.). This will translate into requirements for engineering to issue the corresponding Piping Material Take-Off's and for procurement to place the purchase orders for the various materials.
Corresponding dates must be defined by the Project planner taking into account procurement cycle time, lead time for the various materials and transportation time.

Timely delivery and installation of mechanical equipment

In order to proceed with piping erection with a good productivity:

- at least 60% of equipment have to have been erected so that their nozzles are there to connect pipes,
- the platforms on equipment have to be erected to allow access to personnel for pipe installation,
- pipe-racks must be erected and released, i.e., bolting and alignment done,
- the underground networks (pressurized pipes, sewage, cables) must have been installed and backfilling done so that cranes can access to lift the pipe spools to erect.

Detailed engineering and pipe supports availability

Piping pre-fabrication does not proceed directly with the isometric drawings issued by Engineering but after some processing of these drawings, by the construction contractor, called "spooling" and resulting in the issue of "shop isometric drawings". The time taken by spooling must be considered and adequate resources mobilized.
Effective installation of piping will also require availability of pipe supports. The latter are very numerous. Their standardization and timely mass production must be properly planned in order to allow concurrent installation with that of the pipe-work.

Conclusion

Project managers and project planners too often dwell in too complicated approaches when it comes to determine project durations. The key is always to understand what is the chain of activities that actually will drive the project delivery. This paper proposes a uniquely elegant approach to project management for oil-and-gas projects using piping as the critical chain, and a number of extremely useful rules-of-thumb to determine the expected project duration.

Hervé is the author of "The Oil & Gas Engineering Guide" (Editions Technip). He conducts training in Engineering, Contract Management and Project Control. For more information and a number of additional useful resources please consult his blog: http://www.toblog.fr/fr/baron.html.

