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How to Overcome the Dangers of Facility Replication

From time to time, the duplication of an industrial facility is attempted, with the aim to reap economy of scale and gain schedule and cost performance by exploiting a learning curve. However, a number of parameters will prevent taking the expected benefit of such an approach. This White Paper describes the key parameters to be considered by the Owner when the duplication of a facility is attempted so as to manage expectations about the actual gains that can be obtained.

Duplication or short series have a very substantial savings potential

In several industrial fields, series effects are measured to be very significant even on very complicated objects. Examples include shipbuilding (concept of sisterships), small series manufacturing such as trains, aircrafts and many other fields. The benefits of duplication is substantial and can lead to significant savings even with very short series of 2 or 3 copies. Savings include economies of scale on engineering, cost and schedule savings for the procurement of material and equipment and for construction of the plant, and further benefits during operations in terms of lessons learnt, mutualisation of spare parts and scale effects on maintenance and upgrade works.

It is thus natural that the same order of savings be sought also for industrial facilities through a replication approach.

Stumbling blocks of industrial facility replication

We often observe that what is believed to be a “duplicated facility” in reality bears little in common with the first iteration, but that this is not understood by the owner’s management. Therefore, the lack of substantial benefits comes as a surprise.

Issues that may prevent effective benefits from the replication approach can be categorised according to four main aspects, which are more or less controllable by the Owner. In order of controllability:

- Design improvement or change
- Industrial strategy (suppliers and subcontractors)
- Site-related factors
- Regulatory factors

Design improvement factors

There is always a tendency from engineering to try to improve the existing design from the previous iteration. This however prevents learning curve effects and creates new risks. When duplicating a facility, it is essential to forbid any design change except those that may be required from site factors, and those must be strictly vetted to minimise risks. A strong technical discipline must thus be maintained throughout the project to minimise changes and what could pass for improvements, except of course the feedback from the previous builds in terms of constructability and commission-ability.

Industrial strategy factors

For a full duplication, suppliers of equipment and contractors for construction should be the same to enable full mobilisation of the learning curve. This constraint may not be welcomed by procurement functions and may create issues with suppliers and contractors if it had not been anticipated. Also, external stakeholder aspects (e.g. local content requirements) may require adopting local suppliers or contractors. In any case, any change to the original suppliers and contractors will lower the benefit of facility duplication so that those changes should be minimised as much as possible in particular on the core process and technology, and associated equipment.

Sites factors

Many changes to the facility design and project execution will be induced by the site, in particular if the site of the duplicated facility is different. Key parameters include:

- Possible feedstock characteristics variation
- Changes to cooling capacity of available cold sinks
- Layout changes due to the available site geometry
- Soil characteristics impacting foundations and underground network design
- Seismic characteristics impacting civil engineering
- Climatic conditions
- Site access and logistics arrangement for the construction phase, which may for example exclude modular construction strategies
- Etc.

These changes due to the site apply if the duplicated facility is on a different site, but some may even apply on the same site – e.g. geotechnical characteristics and layout constraints may be different even on the same site for two plants.

Regulatory factors

Finally, regulatory aspects may greatly influence the need for changes in the facility. This is of course the case when the duplicated facility is destined for another country (from building and construction codes to different regulatory requirements for hazardous facilities), but can also apply in the same country if there is a substantial delay in the duplication, as the regulatory framework and requirements may have evolved in the meantime.

Achieving a facility duplication requires a lot of discipline to avoid unnecessary changes

Assessing the actual duplication degree of the facility and anticipating the benefits

Based on the analysis of all the aspect that will induce changes, it is safe to assume that in the realm of industrial facilities, true duplication is never fully achieved. Some degree of duplication will be achieved which can be measured in terms of percentage of facility value. The essential part is to achieve a duplication of the core process and, as much as possible, of the main utilities, and benefit from an effective learning curve from suppliers and contractors.

Measuring the actual degree of duplication is a way of managing expectations as to the actual benefits to be expected from the approach. Economies of scale and learning curve expectations should only be applied to the part of the facility that is effectively duplicated.

Key drivers for successful facility duplication

Based on the previous analysis, some key factors can be identified for reaping benefits from the duplication approach for industrial facilities:

- A very strict discipline to avoid design changes,
- Using as much as possible the same suppliers for key technology items,
- Making sure the learning curve will be present for construction by requiring at least some degree of the construction supervision to be transferred from previous projects,
- Choosing sites that allow similar logistics and construction strategies to be applied in terms of access and site configuration.

Because Facilities are never truly and completely duplicated, it is essential to qualify the share of the facility that will effectively be duplicated to understand actual benefits.

Conclusion

Duplicating an industrial facility and reaping the full benefits of a short series effect is much less straightforward than for manufacturing of complicated objects produced in short series.

Many factors conspire to make the new facility in reality quite different from its initial model. It is essential to have discipline to avoid as much as possible changes so as to reap at least a part of the economy of scale and learning curves. This requires a thought process that should start even prior to the first facility by implementing a design and contracting strategy that anticipates multiple facility constructions.



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