OTC
Owner Team Consultation

Technology Selection

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Introduction

One of the basic accountabilities of the owner/operator in the realisation of a capital project, is to ensure that the right projects are selected. This includes ensuring a good fit with the company's business strategy, understanding the future trends in product markets and selecting the best (and most cost effective) technology for the particular project.

This paper explores the factors to be considered in selecting competitive technology from a number of available technologies. It also touches on the use of new, unproven, technologies and in-house technology development.

Business Case for a technology selection methodology

Selecting technology for a capital project can put substantial value at risk. The influence curve in Figure 1 shows how managements' ability to influence the outcome (potential to impact value) of the project diminishes with time as one moves through the project stages.

Technology options are identified during the initiation phase of a project and the selection of the most competitive technology takes place early in a project, typically during the latter part of prefeasibility; hence the need for a thorough and disciplined selection methodology. Once a technology choice is made, the engineers can use process simplification, or other value engineering methodologies and value improving practices (VIP's), to ensure that the technology is optimised to provide the most cost effective solution.

Technology selection – factors to consider

A disciplined technology selection methodology involves technology and licensor comparisons from economic, technical, environmental, operability & reliability, and commercial standpoints. Evaluation criteria are listed in each of the categories that are applicable and relevant to the specific project/site. Divergent thinking during the early phases can be extremely valuable. There are usually several solutions to a problem and it can be wise to challenge the site's situation and identify all the paths that are available before ultimately selecting the solution that is most appropriate for a specific situation.

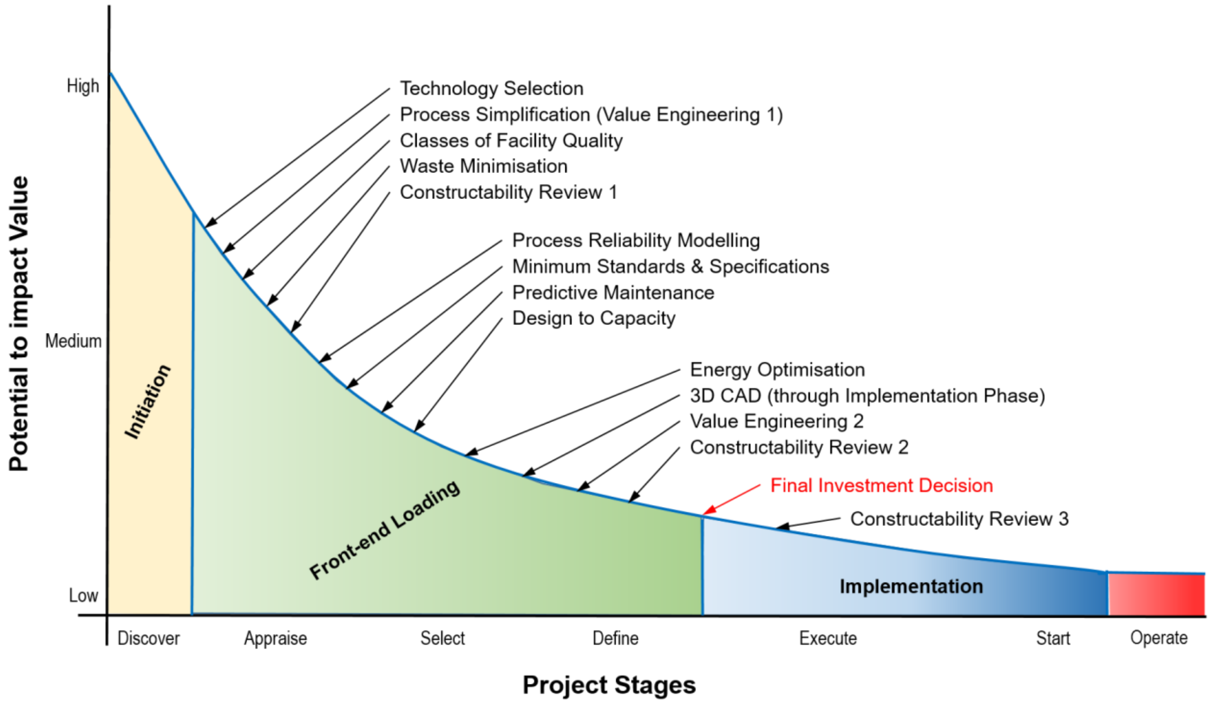

Figure 1: Potential to impact project value vs. project stage (adapted from Porter, 2002)

Figure 2 illustrates the steps taken in narrowing down the technology options. If there are two or more different technologies/process configurations to the same product, an economic benchmarking exercise should be carried out by comparing the cash cost of production for each as well as initial capital expenditure requirements. The aim is to be one of the lowest cash cost producers in order to remain competitive and in business in the long term.

The evaluation criteria are usually listed in three main categories: economics, technology (including environmental) and commercial, with a corresponding weighting for each category. Each of these categories is discussed, in turn.

- Economics would typically have the highest weighting of the three categories, say 40 to 45%, and would include:
  - Capital cost (includes approximate outside battery limits and infrastructure capital);

- Total operating cost including maintenance & manpower; utility, catalyst & chemicals costs;
- Cash cost of production (includes feedstock costs), and;
- Economics – ROI, NPV etc.

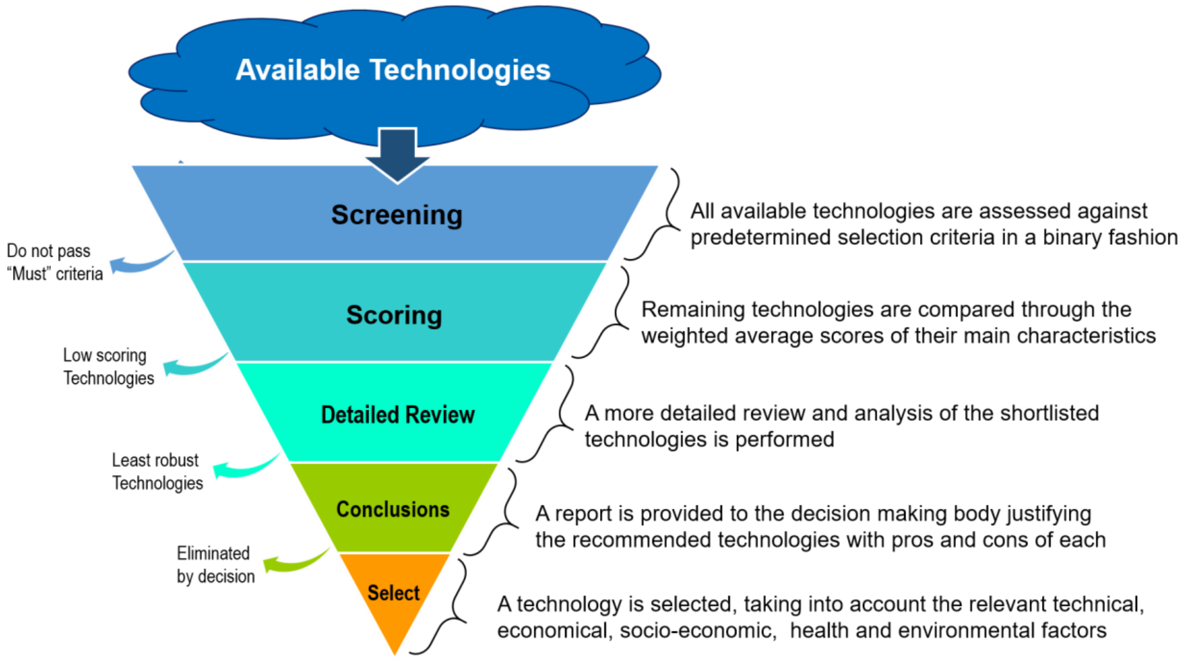

Figure 2: Technology selection steps (adapted from UNEP, 2012)

- <u>Technology</u> would typically be weighted 35 to 40% and would involve a technical review of licensors' offers and assessment of technical risk, and licensors' experience and capability:
  - Acceptable feedstock quality, products meet sales specs;
  - Conversion or separation efficiency; energy efficiency;
  - Licensor experience (number of recent licenses, number of plants in operation);
  - Catalyst experience & availability;
  - Process robustness & reliability (including turndown; shutdown & start-up durations);
  - Plot size required;
  - Safety & environmental factors (solvent, catalyst disposal; waste streams, handling & logistics), and;
  - Process guarantees.

Site visits are recommended for final evaluation of each licensor offering (when narrowed down to the last two options), including discussions with plant operating personnel and access to operating data.

- Commercial criteria are usually weighted 20 to 25% and would include:
  - License fee, PDP and Engineering fee (and payment schedule);
  - PDP contents including list of proprietary equipment;
  - Catalyst supply & costs (and supply agreement);
  - Cost of licensor commissioning and start-up support;
  - Liquidated damages;
  - Licensor representation close to site, and;
  - Intellectual property landscape (freedom to operate).

The Technology Selection Value Improving Practice (VIP) provides excellent guidelines and checklists for technology evaluation and selection (IPA, 2016).

New Technologies

New technologies are developed all the time and will, almost certainly, be part of the available technologies from which to choose. These can be licensor offerings, or technologies developed in a company's own research and development (R&D) facilities.

New technology can provide substantial capital and operating cost benefits, if it has been properly developed through all the R&D stages, and demonstrated from bench scale through pilot plant to semi commercial scale. This includes providing pre-marketing product samples to potential customers for analysis and testing. However, technologies with little real commercial demonstration represent increased risk due to uncertainty, inaccuracy in design data and, often, operability issues during start-up. Hence, the benefits of new technology have to be weighed against the impact that the new technology's performance will have on the overall complex's operation.

If one (or more) of the licensor offerings being evaluated includes new technology, an in depth technology development evaluation will need to be done. An in-house R&D team with relevant expertise (plus independent expert(s)) should visit the licensor development facility and discuss key aspects of the development, including piloting and semi commercial demonstration and design data collection (and repeatability). If a decision is made to go ahead with new technology and it is "first of a kind", there is considerable scope to negotiate a lower, or zero, license fee, weighed against the increased risk.

Circumstances could be such that a technology is strategically important and a company has no choice but to develop their own technology in-house. For example:

- Existing producers closely hold the technology and are not prepared to license it;
- No technology is available that is suitable for a particular unique feedstock;
- High licence fee/royalties that make the project marginally economical, and;
- Restrictive conditions such as "one plant only" licence which restricts future plans.

In order to develop its own technology, it is essential that a company carries out a realistic assessment of in-house expertise and resource requirements, and determines a realistic development schedule following their R&D stage gate model. A joint development programme with a suitable technology partner/supplier could potentially shorten the schedule and bring additional resources and expertise. A full analysis of the intellectual property position will need to be carried out in order to understand patent coverage. How many players? Who is active? Have patents expired? Are there unique or special proprietary catalysts?

Concluding Remarks

Technology selection represents a crucial decision in the early stages of a project which can have a substantial impact on the economic viability of the project. Hence the need for a disciplined technology evaluation methodology to ensure that the most appropriate, efficient and cost effective solution is selected. New technology can provide benefits and this should be weighed up against the increased risk resulting from inaccuracies in, or insufficient, design data and often prolonged start-up duration.

In-house technology development may be the only choice and an in depth evaluation of company resources, expertise and equipment (pilot plants) should be carried out. A realistic schedule should be compiled, including all key development activities, following the R&D stage gate model.

References

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