IMPROVED PROCESS DESIGN EVALUATION THROUGH ENHANCED COST ANALYSIS INTEGRATION

ARTICLE BY RAFAEL CORONEL (Engineering Effectiveness Business Manager - Honeywell Process Solutions) AND STEFAN BAKKER (Sales Engineer - Cost Engineering Consultancy)

CHALLENGES
During these challenging times the oil and gas production, gas processing, petroleum refining and chemical industries need to be able to identify economically viable projects as early in the design process as possible. Every man-hour spent on non-profitable process designs results in opportunity costs that could have been used to accomplish the following objectives:

• Engineering Time & Cost
• Informed Decision Making
• Engineered Cost-Savings

By allowing engineers to quickly and easily determine the cost implications of their process design choices, it will reduce the number of man-hours spent on evaluating expensive process configurations and validating data to support decision trade-offs.

• Re-use of (Cost-)Engineering Knowledge
When process engineers are more involved in the cost aspects of projects it will become much easier to re-use information about cost objects when preparing the process design, resulting in more cost effective solutions.

To achieve this, the process engineer and cost engineer need to intensify their cooperation during the conceptual phase. Not only traditional communications, but also software tools are essential to accomplish this.

This article explores today’s software solutions, capable of integrating the process design with cost information, allowing for informed decision making during the conceptual design and FEED phases.

PROCESS, MECHANICAL, PIPING AND COST ENGINEERING
In many companies, the process-, mechanical-, piping- and cost engineering departments are segregated. The exchange of information follows an ‘over-the-wall’ principle, where people from different disciplines are not fully aware of each other’s concerns and priorities. It is important though to have a good open communication platform between these disciplines, as they are closely related to each other. For example, the placement of the equipment items determines to a large extent the costs of the main pipelines. The complex task to come to an optimal plot plan requires interaction between the different disciplines.

A traditional process design requires input from different engineering departments, such as civil, piping and mechanical engineering. In order to evaluate the cost implications and economic viability of a project, the cost engineer should assess the different design alternatives. This requires an optimal flow of information between process engineers and cost engineers.

The automation and digitalization of most activities makes it possible to have easier access to useful information in early phases of project development. Still, both process engineers and cost engineers have their own separate software tools to respectively design and estimate the project. It is good to have these dedicated tools, as they are specifically designed for process design and cost estimating purposes. Though, in case the information cannot easily be exchanged between the different tools, it could become a complex and especially time-consuming task to evaluate the cost implications of each design alternative during the conceptual and FEED phase. As a result, a decent estimate can only be prepared for one or two design options. But what if we could easily exchange information from process design to cost engineering software? INTEGRATING PROCESS AND COST ENGINEERING SOFTWARE
To illustrate the advantages of integrating process design software and cost engineering software, we will look at two global software solutions that have joined forces to integrate the information flow: Honeywell’s UniSim® Design (process simulation; figure 2) and Cost Engineering’s Cleopatra Enterprise® (cost engineering).

Before looking at the interface between these two systems, it is important to understand the cost estimating methodology that is commonly applied during the conceptual and FEED phases of a project. In the end, this determines the required information that should be transferred from process design software to cost engineering software.
Traditionally, equipment factored methodologies, or simply “factor estimating”, is applied during the conceptual and FEED phases of project development, the accuracy of the TIC estimate strongly depends on getting the right cost values of your equipment. This in turn requires precise and correct information about equipment parameters like sizing, metallurgy and capacity. Cleopatra Enterprise for example, will use these equipment parameters as an input to its parametric equipment models (based on cost estimating relationships) to come up with an accurate estimate of the equipment.

To be able to quickly screen and compare different project designs on costs and economic viability, a cost engineer needs to get the equipment parameters as an input from the process engineer to make a factor estimate. This is where the integration between UniSim Design and Cleopatra Enterprise comes in. Because of the direct link between the two systems, it has become possible to feed the process data directly from UniSim Design into Cleopatra Enterprise (figure 3). Once the process data has been imported into Cleopatra Enterprise, the UniSim Design process data will be automatically mapped with Cleopatra Enterprise’s cost models to produce a cost estimation for the simulated project scope (figure 4).

Because of the automation of the information exchange, process designs can be estimated in less time, allowing for the estimation and consistent comparison of multiple design alternatives (figure 5). This will provide insight into the cost implications for each option. As a result, only the (most) profitable designs will be developed further, reducing the amount of (re-)engineering effort.

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NEW APPROACH: OBJECT ORIENTED ESTIMATING

Next to the above mentioned factor estimating methodology, Cleopatra Enterprise supports the cost engineer throughout the complete project life cycle, allowing for a new and more advanced estimating methodology: object oriented estimating.

Because Cleopatra Enterprise is a central hub for all project data, it is possible to identify characteristic values from executed projects.

These characteristic values can be used to create ‘cost objects’, combinations of characteristic values for each discipline, representing the associated scope (figure 6). A cost object can be for example a pump with associated foundation, piping, instrumentation and electrical work. The cost objects are driven by the quantities of the characteristic values. These quantities (the generic equivalent of MTO quantities) can be priced using Cleopatra Enterprise’s cost databases for estimating, to derive the total project cost (figure 7).

One of the main advantages of focusing on quantities rather than costs is that quantities are better understood by the engineers and designers and thus improve communication. (See page 71 for more information about object oriented estimating.)

Coming back to the UniSim Design and Cleopatra Enterprise integration, object oriented estimating can be applied in Cleopatra knowing the equipment type and its main parameters (size, metallurgy, etc.). For example, if Cleopatra Enterprise gets the equipment parameters of a 40m3 tank from UniSim Design it can be matched to the associated cost object in Cleopatra’s cost database which contains not only the high level equipment cost, but also a detailed built-up of the costs and quantities associated with this equipment. No longer are the costs for piping represented by a single number based on factors, but due to the characteristic values a hierarchical structure of the quantities and costs will be given for the different disciplines.
Getting a good insight in the technical as well as the economic viability of a project during the conceptual and FEED phases. Recent software developments allow for a tight integration between process design and cost engineering software, making it possible to compare design alternatives and choose the most profitable solution. The link between UniSim Design and Cleopatra Enterprise highlighted in this article shows an integrated solution. This solution supports not only the traditional factor estimating methodology or using conceptual design and FEED, but also object oriented estimating, a more advanced estimating method based on characteristic values and quantities. Throughout the development stages of the project, Cleopatra Enterprise supports also detail estimating and can even close the loop by identifying new characteristic values or improve existing ones. In short the integration of process design and cost engineering software will result in:

- **Informed decision making**
  - By having a clear understanding of the cost implications of process design alternatives, better informed decisions can be made.
  - Already during the conceptual phase one can choose the ‘right’ project, based on not only technical but also economical factors.

- **Engineering cost & time savings**
  - The “UniSim Design – Cleopatra Enterprise” interface will significantly reduce the estimating time for the different process alternatives, while at the same time the number of re-engineering hours will be reduced, because unprofitable process designs are identified early on in the project development stage.

For more information please contact:
**Cost Engineering**
Sjef Bakker
sbakker@costengineering.eu

**Honeywell**
Rafael Coronel
rafael.coronel@honeywell.com