

THE VALUE FIRST-PRINCIPLES PROCESS SIMULATION BRINGS TO REFINING

An enabler to plant asset operational excellence

Introduction



UniSim® Design Suite is Honeywell's process simulation solution which is a world-class product for process design, optimization, and operational monitoring. It is a decision support platform, on which the process is represented by a first principles model, respecting the thermodynamic, heat transfer, separation processes, chemical reactions and fluid dynamics principles.

UniSim Design Suite is used by end users or operating companies in different industry verticals: Oil and Gas, Refining, Petrochemicals, Chemicals, Power Generation, and Biofuels. In addition, it is used by companies serving the end-users or operating companies, such as technology licensors, Engineering Procurement Contractors (EPCs), engineering consultants, and process equipment manufacturers.

This white-paper provides use cases of how each player in the refining market can use our process simulation technology and what value such use may yield.

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About UniSim Design for Refining

What It Is

UniSim® Design for Refining is the sub-set of products licensed under the UniSim® Design Suite, which apply to the refining simulation market. They include products for:

UniSim Design for Refining is a sub-set of products licensed under the UniSim Design Suite, which are applicable to the refining simulation market.

1. Plant design, simulation and optimization – to create flowsheet models in steady-state or dynamics mode, representing the process of interest
2. Physical properties – to regress or to access specialized thermodynamic packages
3. Conceptual design – to design and optimize heat-exchanger networks and to enable offline operational decision support
4. Safety system design, rating and simulation – to design, rate and select the appropriate construction material for blowdown, flare and pressure relief systems
5. Heat-exchanger design, rating and simulation – bundles of modules with UHX and HTRI technology, for the design, rating and simulation of different types of heat-exchangers
6. Refining-Market Specific Products – to model refining reactors, to enable the calculation and propagation of refining properties, and to import or define crude assays



1 - AMSIM is a Schlumberger product.

2 - OLI Electrolytes and OLI Corrosion Analyzers are OLI Systems products.

3 - Option contains HTRI Xchanger Suite® and HTRI XSimOp™, which are HTRI products.

Figure 1. Process Simulation Products for Refining

One thing to highlight is that the UniSim Refining Reactors, which represent rigorous conversion unit reactor modules, are built within the UniSim EO (equation oriented) environment. This is an integral part of the UniSim® EvOluTion, high-performance, next generation platform, which enables process design and optimization under the same environment. It helps users to easily configure large flowsheets with rapid convergence times. It also bridges the offline process simulation world with the online real-time solutions space, extending the lifecycle value of simulation models and reducing the total cost of development.

What Value Does it Give

Having a first principles model of a refining process, enables users to :

- design new processes or catalysts
- ensure the process design and operations are viable
- minimize CAPEX or OPEX or both
- investigate the effect of a new crude on the process
- predict product yields
- carry out HAZOP or process debottlenecking studies
- update scheduling and planning tools
- monitor plant operations (digital twin).

Differentiated Technology

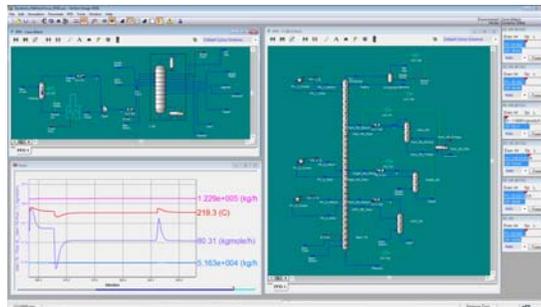
Honeywell's simulation technology is uniquely positioned to address the refining simulation market, for the following reasons :

- **It is build by users, for users** – internal and external domain experts are engaged in the design and validation phases of the UniSim Design Suite products ; this has helped develop products that address the customer needs in terms of functionality and workflows, at an accelerated speed of innovation.
- **It is truly multi-purpose technology** – simulation, operation support, and optimization are enabled under the same platform. Models developed at the early stages a project (i.e. feasibility studies), can be updated and enhanced in the consequent stages (i.e. FEED, detailed design, HAZOP studies, operational procedure development, DCS check-out, operator training, and operational de-bottlenecking), yielding value throughout a project and/or plant asset lifecycle. In addition, models can

be easily extended into new high values solutions, such as "connected" plant operational support.

- **It is built with a vision in mind** – the simulation space is under transformation. Users have new requirements, which require support for new business models. The Honeywell EvOolution platform, is the next generation platform, with speed and execution efficiencies capable of delivering such new requirements. It is now possible to bridge the offline modelling world with the on-line real-time solutions space, to carry-out plant-wide modelling and optimization, and to conduct remote process monitoring services.

UniSim® Design Suite is a multi-purpose process simulation solution. Process design, operational monitoring, and optimization are now possible on the same simulation environment, leveraging the UniSim® EvOolution next generation platform.



Crude Distillation Column Model in UniSim Dynamics

How is it Offered

The UniSim Design Suite technology is offered on a lease basis as off-the-self software. Users may chose the products of interest and the access type (standalone, network or token licensing) they need. Software support and free upgrades are provided for all leased software.

In addition, UniSim Design is offered as a component or enabler in project-based advanced applications, such as Operator Training Simulation, Advanced Process Control, Asset Management, Corrosion Prediction, and Supply Chain Management.

Finally, UniSim Design features as the “digital twin” for remote operational monitoring and consulting services over the cloud. It calculates expected plant performance, which is compared

UniSim Design for Refining products can be used by different types of users for a variety of use cases. Benefits include significant increases in engineering productivity and plant availability, and significant reduction in CAPEX and OPEX.

with the actual plant performance. Any deviations are reported and monitored by an operations consultant.

UniSim Design for Refining Use Cases

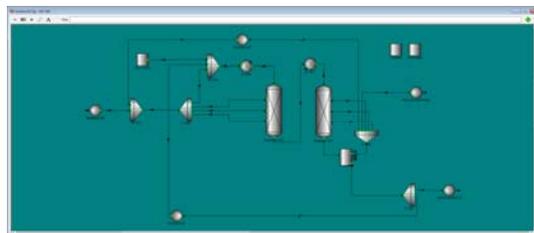
Yield Prediction

Refinery plant-asset owners or operating companies, need to assess the impact of new or opportunity crudes to the refinery production. This information is needed in order to make decisions regarding:

- **Planning** – purchasing of crudes to process in the refinery; annual, quarterly, and monthly plans
- **Scheduling** – feed blends to process; monthly, weekly, and daily plans
- **Operations** – operating envelope to adjust to and controller set-points; daily production plans

Decision support for scheduling, planning and production is very important, as refiners need to meet contractual obligations with their customers (in terms of volumes, quality of products, and timeliness of delivery) and operate with maximum profitability (reduce waste and minimize OPEX).

UniSim Design is employed to create flowsheets of the refinery process (in whole or in part). The simulation models generate LP vectors to update scheduling and planning tools, thus they close the gaps between scheduling, planning and production plans. The benefits of having consistent plans are 3-8% increase in throughput, which translates to multi-million dollars of revenues in daily production.



UniSim Hydro-Processing Unit PFD

Operational Monitoring

Process engineers working for refineries need to

ensure the process is running within the recommended operational envelope for the daily production plan. This is necessary in order to:

- Meet the expected production and product quality
- Avoid disturbances, unplanned maintenance, and potentially costly process shutdowns
- Save on utilities and chemical injections
- Lower emissions

UniSim Design, featuring as a “digital twin” in operational monitoring services over the cloud or as part of asset management solutions, provides the insight to refiners on how well they operate their plant, how much catalyst life is left in their conversion units, and whether action may be needed by operations, and whether preventative maintenance may need to avoid issues in the forecasting horizon. Typical benefits refiners get through operational monitoring are:

- 2-8% increase in plant availability
- 5-15% reduction in maintenance costs
- 5-10% reduction in energy usage

New Process Design Feasibility

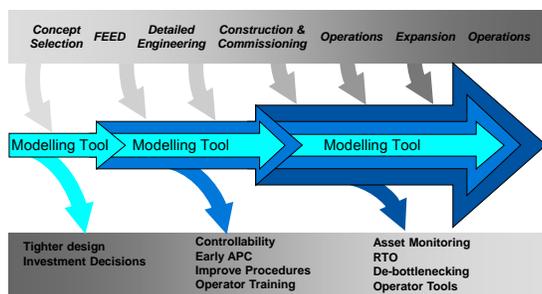
Technology licensors in the refining industry, continuously assess the feasibility of new process designs or new catalysts for refining conversion units. In order to be able to compete in their market, they need to ensure the processes they license, can meet the production objectives in terms of production rates and product quality, are safe, yield better profitability margins (lower CAPEX and/or OPEX), and can provide all this information at the project bid stage.

Using UniSim Design, process technologists can easily assess the feasibility of the new designs and can conduct preliminary equipment sizing and costing to support their bids. A typical benefit for technology licensors who employ commercial simulators as opposed to using legacy tools is 25-33% reduction in bid preparation time, in addition to achieving optimized designs.

Engineering Design

Users in the Engineering Procurement Construction (EPCs) industry, undertaking any type of project (greenfield, revamp or expansion) for a refinery, need to carry out studies, before the construction phase begins:

- **Basic Engineering Design (BED)** - feasibility studies and rough project cost estimate; consolidation of packages by process licensors
- **Front-End Engineering Design (FEED)** – preliminary sizing and rating of process equipment; specifications for material procurement
- **Detailed Engineering Design (DED)** – detailed design and validation of process equipment, instrumentation, and controls; preparation of operating procedures; documentation for handover to operations.



Lifecycle Approach for Process Simulation

Having a platform which supports multi-purpose simulation, such as UniSim Design, is an invaluable tool for EPCs. It enables them to update the models derived at the basic engineering design stage and use them in throughout the FEED, DED, and handover to operations, thus ensuring the designs have an audit trail and no information is lost with the transfer between groups and functions. In addition, the accuracy of prediction that UniSim Design provides, allows EPCs to select the appropriate construction material and size appropriately the equipment, resulting into significant savings in CAPEX. Finally, having the industry standards, sizing, rating, and documentation generation capabilities in the same tool, considerably increases engineering

efficiency. Typical benefits EPCs get through the usage of commercial simulation software are:

- 10-30% reduction in CAPEX
- 20-45% engineering efficiency gain

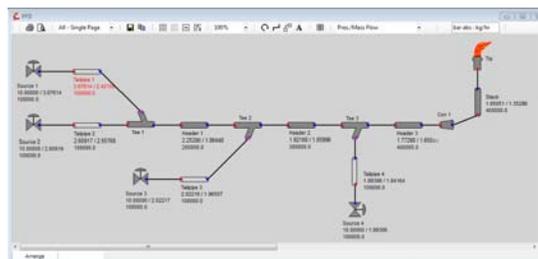
Engineering Studies

Engineering Consultancy firms may be hired by EPCs or Operating Companies to carry out specialist studies, such as HAZOP, pressure relief and flare system studies, and specialist package design. These are necessary in order to:

- Complete the DED phase
- Validate that the designs meet the operational, safety and reliability requirements for the plant assets
- Certify plant assets for license to operate

Seamless integration and consistency between tools under the UniSim Design for Refining Suite, make it easier for EPCs to outsource work to Engineering Consultants and integrate back their work into the overall engineering project.

UniSim Design for Refining Suite has tools for both flowsheeting and specialist engineering studies, which are consistent and data is seamlessly communicated between them. Engineering consultancy firms working for EPCs or Operating companies can license just the tools they need to carry out their specialist engineering tasks; and the outsourcing companies can easily consolidate the study results into their engineering design. Through data transfer workflows, scenario automation, engineering documentation generation, engineering consultancies may also achieve 20-45% engineering efficiency increase in their work.



UniSim Flare for Flare Design and Rating

Equipment, Instrumentation, and Automation System Validation

The cost and lead time for the manufacturing of

UniSim Design for Refining enables the validation of designs for refining reactors and control systems on conversion units, well in advance before their commissioning. This helps ensure no instrument is missing, the target production can be achieved, and the process operates safely.

process equipment (i.e. compressors, reactors, heat exchangers), and automation systems can be significant for an engineering project. EPCs need to be certain that the design and operation of such equipment, instruments and automation systems is appropriate for the process they are to construct, as modifications on-site may be very time-consuming and costly. Simulation models are employed in order to validate equipment, instrumentation, and automation systems and startup/shutdown procedures, prior to installation on the actual process.

UniSim Design Suite products have been extensively utilized over the last 30 years, to provide such validation studies. Typical benefits EPCs get through equipment, instrumentation or automation system validation by use of simulator are:

- 10-15% reduction in plant startup time
- 5-10% in energy reduction

For More Information

Learn more about how Honeywell's UniSim Design Suite can improve process design, visit www.hwl.co/uniSimDesign or contact your Honeywell Account Manager or authorized distributor.

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WP-18-02-ENG
January 2018
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