CLOCKWORK SOLUTIONS

PRODUCT APPLICATION

Process Industry - Project Experiences and Benefits

Availability Optimization – Integrated Oil Sands Project

Clockwork developed a complete, integrated refining model study for a large Canadian Oil Sands development project from well-head to product delivery that was used to quantify the risk, or probability, that a proposed multi-billion dollar investment could meet the client's business objectives. Creating the integrated model required building detailed, reliability-based models of production fields (using reservoir simulation production profiles), well pads, central processing facilities, pipelines, and refinery units including their storage assets and determining the throughput for the integrated model. The reservoir production was modified, or deferred, if equipment failed. Thus, the well production was shifted in time according to the reliability of the equipment downstream of the reservoir.

After the model was run, availability bottlenecks were identified. Design modifications were made and the model rerun to determine if throughputs had been improved. This process was repeated until the plant throughput met the design requirements.

Availability Optimization – Integrated Gas Plant Design

A US consortium developed a major, new $2.5B hydrocarbons project which included a gathering-field in the Amazon rainforest, an adjacent gas plant, pipelines through rough mountainous terrain that transport the gas and extracted liquids, a fractionation plant, and coastal export facilities.

During the conceptual design phase, Clockwork built SPAR™ models of the project to identify and quantify major project risks and to assist the design team with major project investment trade-off decisions. For example, assessing the value of investing in additional gas compression capacity at the beginning of the pipeline, *versus* more redundancy in the pipeline booster stations, *versus* additional storage capacity at the end of the pipeline.

Optimal Use of Capital Funding

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In the detailed design phase, the SPAR™ models were used to assist the design team with equipment selection to determine the optimal storage tank volume, to assess the operability of the design, to determine the performance and support terms required of the various OEMs, and to begin planning the logistics and maintenance resources needed.

Unit Availability Study – Gasifer-Cogen Unit

Clockwork built a detailed reliability model of a gasifer-cogen plant integrated with a refinery unit. The model was used by the client to predict if the multi-gasifer design could meet performance objectives. Not meeting the performance objectives would require purchasing relatively expensive natural gas to meet the contractual obligations of steam delivery. The original model runs indicated that total system availability was only 82% significantly below the required 90%. The unit was then redesigned when the client realized that the three gasifer system was limited by common downstream units.

Run-Length Optimization – Plastics Plant Turnaround

A US-based plant normally had a turnaround every two years. However, plant management had wanted to determine if turnaround length could be lengthened and duration shortened.

Plant maintained failure, repair, and maintenance records were incomplete and of questionable quality. Life data distributions were created from the data to reflect aging effects, and the distributions were then validated by using them in a SPAR™ model of the plant to predict its past behavior.
Clockwork analyzed several alternative maintenance scenarios. The end result showed that many activities performed during the turnaround were superfluous; eliminating them would not materially affect the forced outage rate. Other maintenance activities could be performed on a less frequent basis.

The primary benefit shown was elimination of nearly three weeks of scheduled down-time over a four-year period. A secondary benefit was reduced maintenance cost due to the elimination of unnecessary turnaround activities.

Tankage Rationalization – Petrochemical Supply Chain

The petrochemical complex consisted of a cracker which converted naphtha into ethylene and propylene and then served as feed to downstream chemical plants. Feed naphtha was delivered by tankers while other feedstocks arrived by train or pipelines. Product ethylene and propylene ran down hot chemical plants and also to storage caverns via pipelines. The caverns served as buffer capacity.

The project intent was to analyze the feedstock and intermediate product supply chains in order to assess adequate intermediate storage.

Clockwork developed a plant model that considered all the elements of the supply chain – planned/unplanned outages at the individual unit and pipeline level, and feedstock arrival times and volume.

The model computed the expected number of chemical plant outages induced by insufficient storage. Initial model output showed a surprisingly high sensitivity in downstream operations to small variations in the naphtha tanker delivery rates. The model's findings led the client's management to revise contractual delivery terms and to resize storage at the delivery terminal.

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