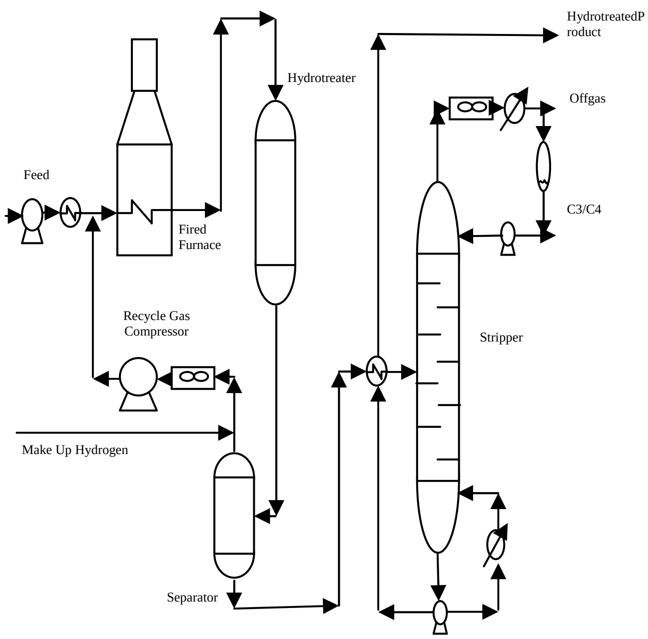
CLOCKWORK SOLUTIONS

PRODUCT APPLICATION

Process Industry - Unit "Availability Throughput" Studies

In a modern refinery or chemical plant, process engineers are often faced with the following question, "Where should I spend my next capital or maintenance dollar to increase unit production capability?" In today's business environment, that question has become more important than ever.



In any process unit, there always exists an optimal balance between additional capital investments in equipment and achieving an ultimate improvement in unit availability, i.e., throughput. Even for an experienced engineer, it is not always intuitive to predict how changes in equipment reliability will affect unit availability due to equipment interactions, sparing philosophies, etc.

Fortunately, Clockwork Solutions offers simulation, modeling, and optimization tools for asset management that give engineers and business managers the ability to increase the long-term unit throughput based on a sound life-cycle analysis technique instead of simply being relegated to educated guesses.

Standard Process Simulators vs. Life Cycle Analysis Techniques

When considering major capital expenditures, engineers are often faced with the cost/benefit of different alternatives. Process engineers have long used process simulation techniques to debottleneck plants. While obviously important, standard industry simulators tend to be steady-state time or have a time horizon measured in hours.

On the other hand, life cycle simulation, the basis of the Clockwork technology, has time horizons measured in years. Life cycle technology is able to make such long-term production predictions because they include the probability of equipment failure and the impact of tankage into their overall throughput calculations.

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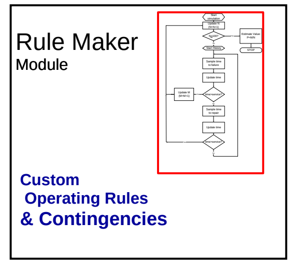
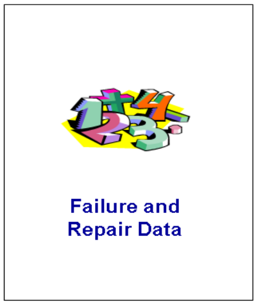
Clockwork's Approach to "Availability Throughput" Analysis



The first step is a small scale FMECA (failure modes, effects, criticality analysis) study.

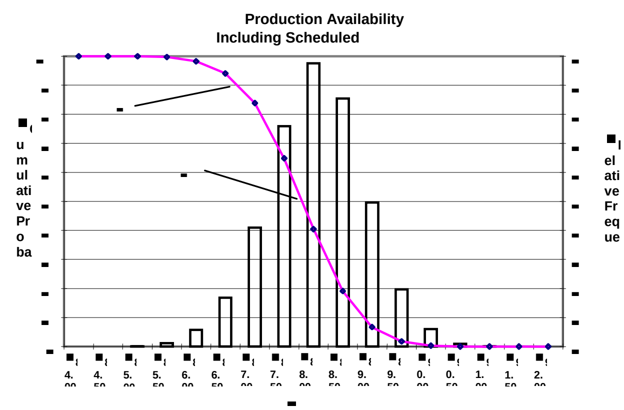


The engineer determines equipment to include in the model, the criticality of that equipment, the redundancy, and the effect if the equipment fails.

In the second step the engineer assigns equipment failure and repair data.

In the third step the engineer identifies any operating logic that would be required to more fully depict system "reality" such as operational changes that an operator makes to a unit during special operating scenarios and interactions among pieces of equipment.

Key Model Outputs

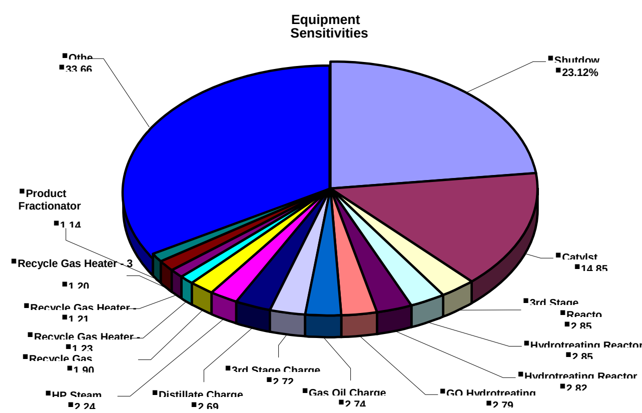


There are many possible outputs that the engineer can use to aid the evaluation of the proposed operating scenario. Among these, however, there are two types that the availability engineer uses consistently - the availability histogram and the equipment sensitivity graph. Using these two charts, the engineer can normally draw significant conclusions about how the particular unit configuration affects availability.

Histogram

The histogram graphically details the probability that the process unit as configured can achieve a given availability.

Equipment Sensitivity



The equipment sensitivity chart details the probability that each piece of equipment in the system contributes to unavailability. The engineer uses the chart to look for large contributors to unavailability and makes improvements if the overall availability was not acceptable. The engineer might also use this chart to look for small contributors to unavailability that had large capital costs. Too often, units are unnecessarily "gold-plated" that don't add any additional value, i.e., making an expensive upgrade on a non-critical piece of equipment. The engineer will make "delta" changes to equipment or process configuration and then will rerun the model to determine the "delta" change in availability. This will allow the engineer to determine the increase in yield for a given capital investment, i.e., the ROI on that investment. The engineer will continue this process until he or she reaches a point of diminishing returns.

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