



Scheduling for Performance: From Managing Inventory to Managing Quality

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Outline



- ▶ Background
- ▶ Business Case
- ▶ Business Value
- ▶ Fundamentals
- ▶ Scheduling Tool
- ▶ Inventory Management
- ▶ Quality Management
- ▶ Benefits

Background



- ▶ Needs for continuous improvement
- ▶ Business climate
 - Economic downturn
 - Profit margin pressure
- ▶ Social responsibility
 - Culture of compliance
 - Dedication to safety
- ▶ Customers' demand
 - On-spec products
 - On-time delivery

Tesoro Business Case



- ▶ Existing crude scheduling tools do not allow schedulers to effectively evaluate impacts of crude deliveries to production plans across multiple locations in a timely manner.
- ▶ Current system consists of a variety of disconnected spreadsheets for each refinery.
- ▶ Spreadsheets do not support impact analysis for deliveries across several locations.
- ▶ Spreadsheet-based business process via multiple spreadsheets is prone to significant error due to multiple manual inputs and controls.

Business Value



▶ Optimization

- The new scheduling tool provides a single system to view production schedules for single refinery or the entire system.
- Inclusion of LP sub-models allows simulations that take into account process unit and logistic constraints.
- Propagation of intermediate and finished product qualities accounts for refinery operational changes initiated by feedstock quality changes.

▶ Supply logistics

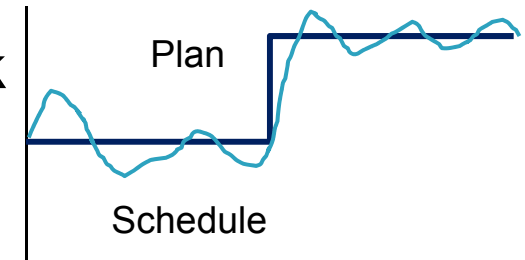
- Multi-user functionality allows improved interaction between HQ and refinery locations.
- Accurate prediction allows inclusion of TBD deals and generation of production run-outs for trading & financial tools.
- Integrated capability eliminates duplication of effort and errors inherent in use of multiple scheduling tools.



Fundamentals



- ▶ Returning to basics
 - Improving the planning-scheduling cycle with accurate production scheduling
- ▶ Planning – optimal targets
 - Setting targets for feedstocks, processing rates, and products
 - Updating plan with scheduling feedback
- ▶ Scheduling – feasible schedules
 - Timing to meet production targets
 - Observing inventory and quality constraints
 - Sending feedback to planning



Responses to Changes



- ▶ Flexibility to respond quickly to changes
- ▶ Planning around unplanned process unit outages
- ▶ Inventory variations
 - Feedstock supplies
 - Unit production and availability
 - Product sales
- ▶ Quality variations
 - Crude slate changes
 - Unit operational fluctuations
 - Seasonal products

Scheduling Tool

Project Definition



- ▶ Implement a crude and full refinery event-based production scheduling with multi-period blending optimization system.
- ▶ Build a corporate system that will aggregate and summarize multi-site schedules to support supply chain scheduling across all waterborne refineries.
- ▶ Scope includes crude scheduling at all waterborne refineries.
- ▶ Modeling of downstream processing and blending implemented as needed to incorporate key refinery constraints.
- ▶ Standardizing with M3 SIMTO Scheduling.

New Scheduling and Blend Optimizing Tool – M3 SIMTO



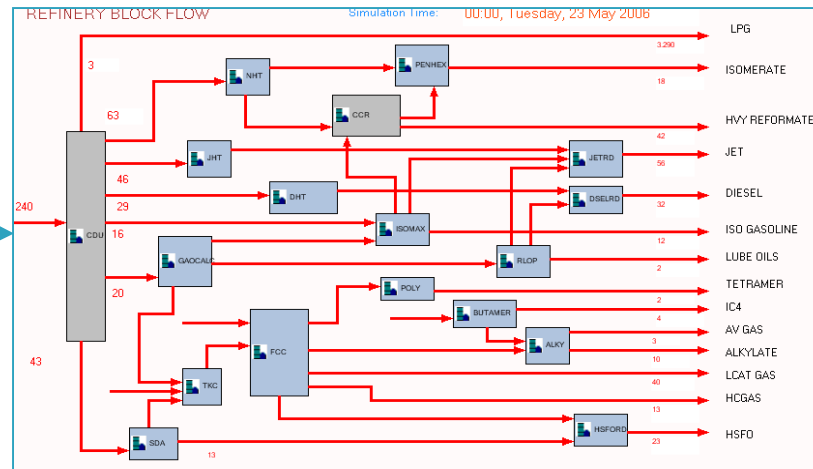
- ▶ The right tool – flexible and fast
- ▶ System features
 - Enterprise architecture
 - Event-based simulation
 - User friendly modeling of facilities
- ▶ Key functions
 - Feasibility check: inventory, logistics, quality constraints
 - User-friendly scheduling interfaces
 - Manual and automatic scheduling logic
 - Ability to reconcile schedules based on actual events
 - Multi-blend optimization

Scheduling Tool

Inventory Management



- ▶ Scheduling assets to meet planning targets
- ▶ Limited storage capacity & inventory carrying cost
- ▶ Limited unit capacity



When to unload crude? How to charge crude unit?

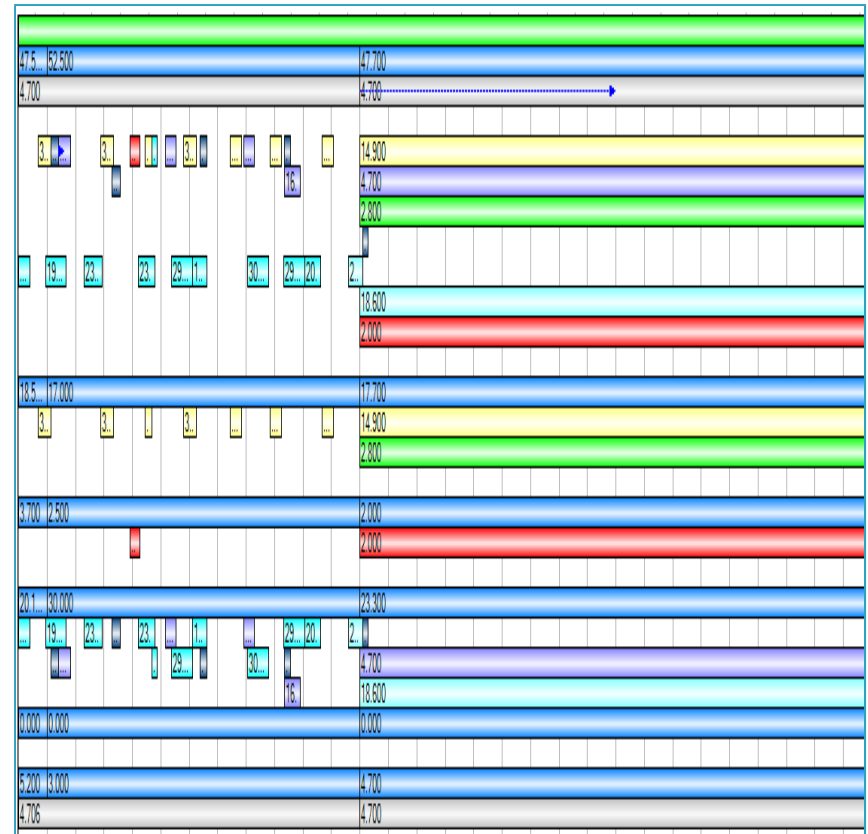
When to ship products? How to blend products?

When to switch the unit mode and rundown tank?

Short-Term and Long-Term Forecasts



- ▶ Receipts and shipments
 - Nomination driven
 - Auto or manual tank assignment
- ▶ Unit operations
 - Inventory and target driven
 - Auto or manual tank assignment



Inventory Management

Inventory Forecast



- ▶ Monitoring inventories
 - Tanks – individual or aggregate
 - Materials – crudes or products
 - Pools
 - Intra-day inventory forecasting

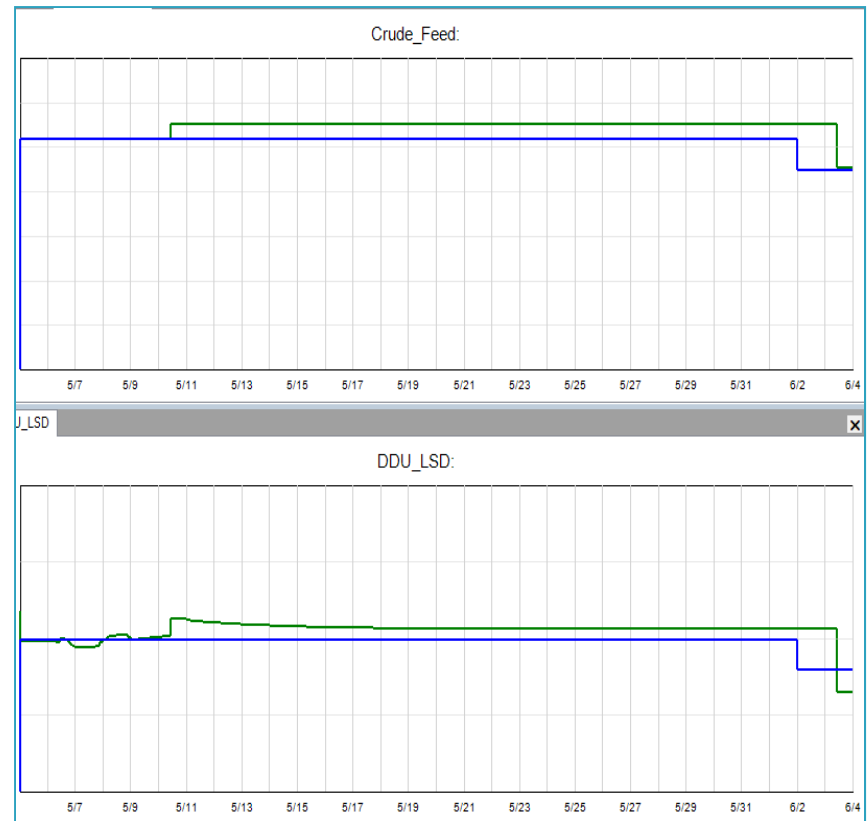


Inventory Management

Operation Forecast



- ▶ Monitoring streams
 - Charge rates
 - Production rates
 - Plan vs. schedule tracking
- ▶ Simulating production
 - LP sub-model yields
 - Updating yields with plant data



Inventory Management

Quality Management

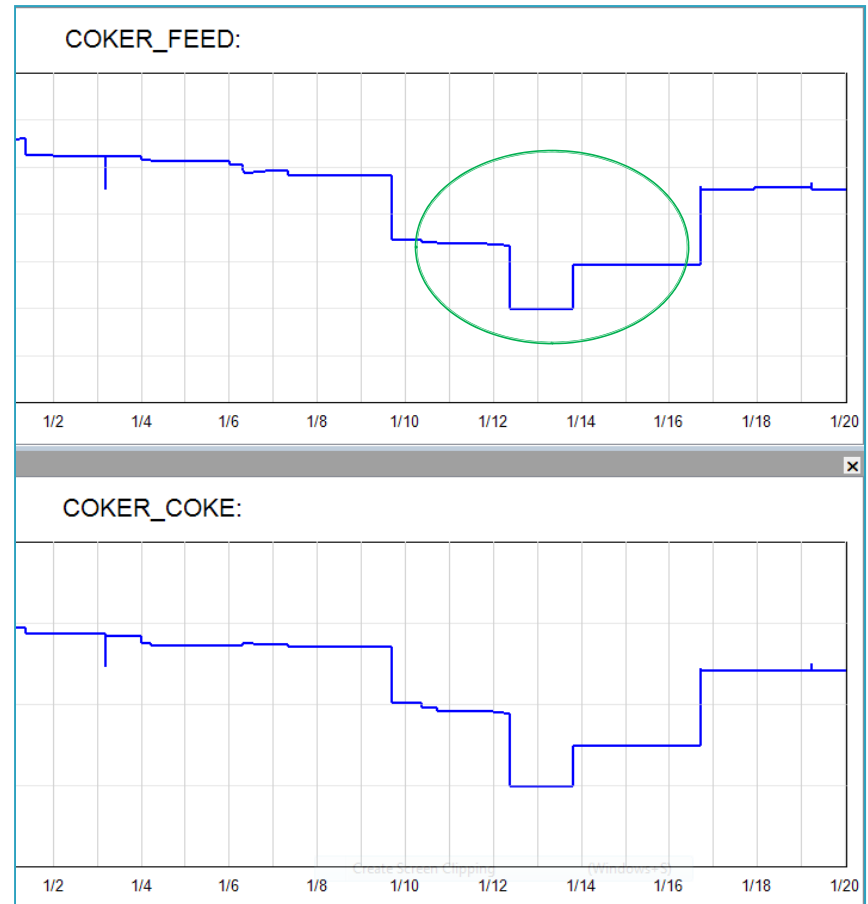


- ▶ Integrating with inventory management to improve refinery performance
- ▶ Accurate quality forecasts
 - Current plant data updates
 - Quality-driven unit modeling
 - Non-linear property blending
- ▶ Meeting quality constraints
 - Product specifications
 - Safety and environment
 - Unit capacity limited by feedstock qualities and products' upgrading requirements

Crude Oil Quality



- ▶ Maximizing throughputs
 - Tracking crude compositions
 - Tracking carbon residues and yield of vacuum resid
 - Adjusting the crude slate to fill the coker

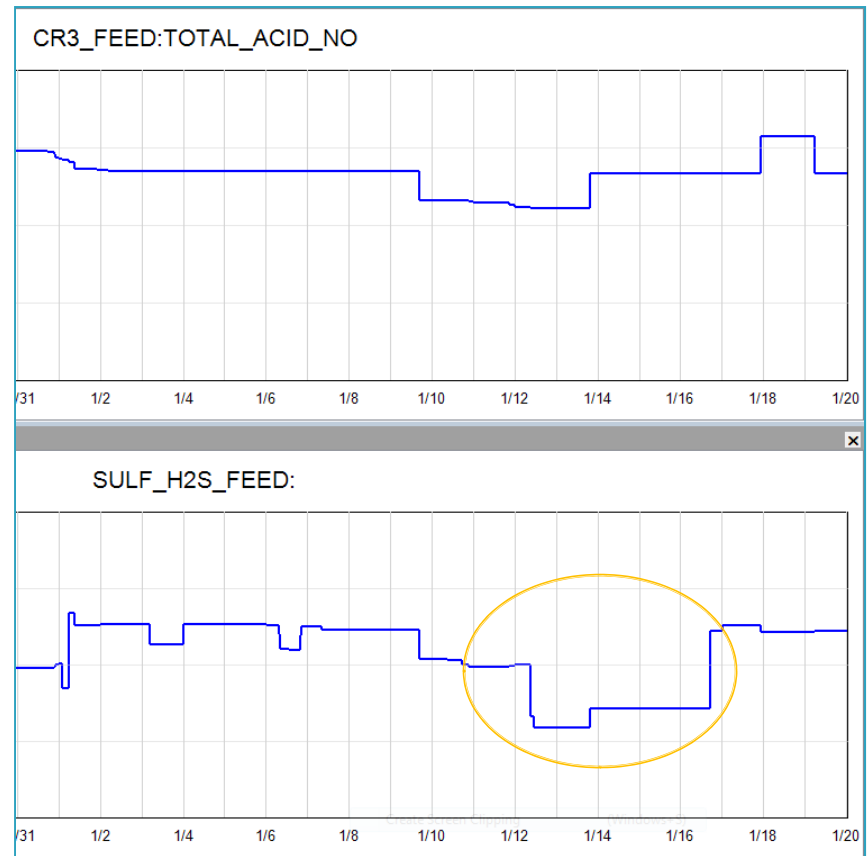


Quality Management

Crude Oil Quality



- ▶ Safety and environment
 - Tracking sulfur and total acid number
 - Predicting the sulfur recovery unit loading
 - Reducing unplanned unit turndown or shutdown

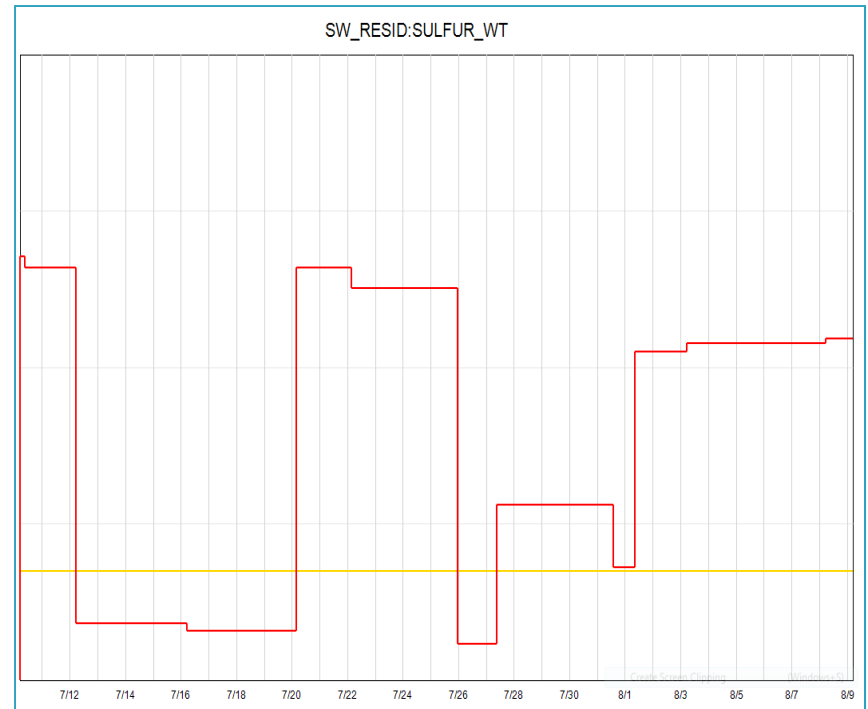


Quality Management

Crude Oil Quality



- ▶ Monitoring trace quantities
 - Predicting tank heel effects
 - Switching operation modes in time
 - Examples – Low sulfur fuel oil, ULSD



Quality Management

Intermediate Stream Quality



- ▶ Impurity limits due to metallurgy, catalyst life, etc.
 - Carbon residues
 - Total acid number
 - Metals
- ▶ Target properties of blend components
 - Olefins, RVP of gasoline components
 - Smoke point, freeze point of kerosene components
 - Cetane index, pour point of diesel components

Intermediate Stream Quality



- ▶ Balancing hydrogen system
- ▶ Managing impurities
 - Sulfur balance
 - Nitrogen balance
- ▶ Balancing finished blend components
 - Blending effects of straight-run materials
 - Optimizing alkylate usage

Quality Management

Product Quality



- ▶ Changing component qualities
 - M-Blend optimizing components
 - Flexibility in setting volume constraints on excess or deficient components
 - Setting closing inventories
- ▶ Changing product specifications
 - Seasonal product changes
 - Managing specifications with blend knowledge base
 - M-Blend optimizing components

Quality Management

Product Quality



- ▶ Managing off-site storage
 - Managing excess components with can-buy / can-sell options
 - Inventory planning for seasonal changes and unit outage – storing alkylate in winter, storing butane in summer.
 - Scenario analysis
- ▶ Managing component supply
 - Predicting component purchases
 - Predicting component sales

Quality Management

Benefits



- ▶ Quick response to changes
 - Opportunity crudes
 - Unit turndowns and shutdowns
 - Sale demands
- ▶ Smooth operation
 - Updating schedules with plant data to avoid gaps and unexpected changes
 - Stabilizing feed to the crude unit
 - Predicting effects on downstream operation – less surprises

Benefits



- ▶ Accurate inventory and shipment forecasts
 - Out-month inventory management
 - Earlier and better trade decisions
 - Scenario analysis – opportunity crudes, split cargos, selling intermediates
- ▶ Integrated operation
 - Quick feedback to planning group to close the planning-scheduling cycle
 - Accurate information and timely direction for traders to make decisions

Benefits



- ▶ Return on investment
 - Savings from improved operation
 - Savings from optimization
- ▶ Lower working capital
 - Efficient usage of crude oils
 - Optimal usage of blend components
 - Some relief from tankage constraints
- ▶ Efficient asset utilization
 - Approaching unit capacity limits without compromising safety and environment
 - Better prepared for scheduled unit maintenance

Tesoro Project Benefits



- ▶ Reduced Demurrage Expense
 - Increased visibility to production plans allows planner to schedule ships with fewer days of planned demurrage
 - Aids identification of opportunities to reduce demurrage costs caused by cascading impacts on split cargoes
 - System wide demurrage savings of 16 days at \$35,000/day for \$600,000/yr.
- ▶ Crude Optimization
 - Improves decision making process around split cargoes to deliver maximum system uplift
 - Better optimization of refinery crude slate to operate closer to key constraints
 - Optimization improvement of \$1/bbl on a single 700 Mbbbl once a year at each of four waterborne refineries for \$2,800,000/yr.

Tesoro Project Benefits



- ▶ 50 ST/day better approach to coke drum outage constraint (2% improvement)
- ▶ 10 LT/day improvement in pushing sulfur constraint
- ▶ 0.05% better approach to crude unit acid number constraint (10% improvement)
- ▶ **Total benefits: \$5 - 10MM/yr**

Tesoro Intangible Benefits



- ▶ Improve precision of forecasting refinery inventory thus improving financial forecasting.
- ▶ The multi-site feature will enable reports for system-wide inventory projections.
- ▶ Increased productivity and efficiency – The new scheduling tool identifies opportunities and frees up refinery planner time to evaluate them.
- ▶ Efforts to improve the scheduling model's yield and quality predictions will also improve accuracy of the LP models.



Questions?