

S-SOM Scheduling and Operations Management

Keeping Your Optimal Operations Plan On Track ...

It is a familiar scenario in the refining and petrochemical world. Companies have done a significant effort in adopting advanced planning and scheduling systems. Optimization models based on mathematical programming have been in use for many years and they have become part of the standard procedure to generate the desired operation plan. One could argue that almost every company in the business has the ability to create an economically efficient operations plan to balance supply and demand.

It could be observed as well that very few companies have the ability to execute their operations while keeping a close adherence to their optimal plan. Immediately after the operation plan is released for execution, the critical activity of managing the environment variability, detecting events that disrupt the coordination and adjusting the actual operation to keep adherence to the planned targets, takes center stage.

Managing scheduled operations

There is wide recognition on how critical the task of achieving the expected benefits of optimally planned operations is. After all, what's the value of an optimal plan that fails to be executed? Despite this strong argument, a systematic procedure to perform this task is seldom found in practice. Neither the systems used to generate the optimal operations plan, nor the manufacturing execution systems provide adequate support.

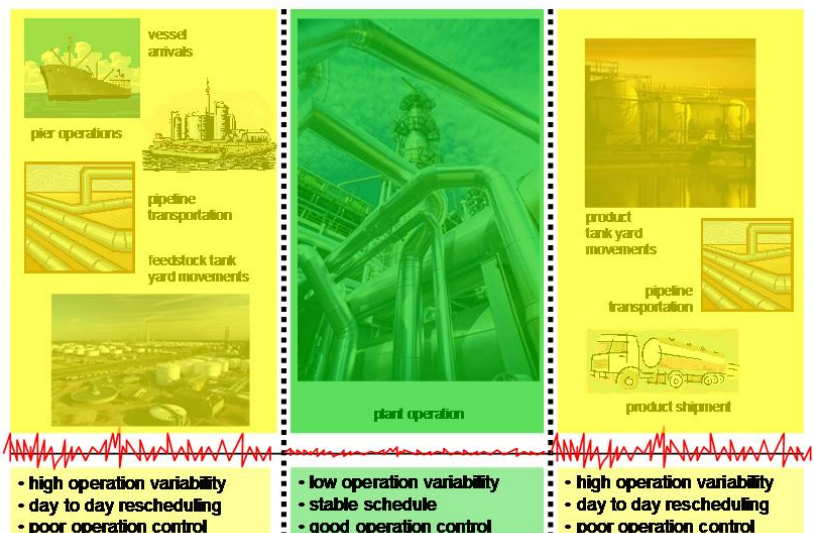
Even those companies that have reached a level of sophistication with Advanced Planning and Scheduling Systems and Advanced Plant Control recognize they have a broken link among these two functions. When doing event management and exception handling, Operation Managers are poorly supported and prompted to make decisions with a rather high degree of improvisation.

On exploring this apparent gap in the business process, the first thing that should be addressed is, why isn't the system that is used to create the optimal operations plan

fitted to support the managing of the execution.

There is a tempting idea along this line: "we already have a model for creating an optimal operations plan, so if something goes different as planned, let's run it again."

If the change in the environment has significantly modified the basic assumptions driving the economics of the previous plan, there is no doubt that a new optimal operation plan must be generated.



However, a much more frequent scenario is that the desired targets remain the same but the operation execution is challenged by unpredictable variations that hinder their completion as planned.

Most of the time, these variations are associated to logistics operations both in feedstock replenishment and finished products expedition. As compared with process unit operations, logistics operations are far less reliable and have inferior control capabilities. They are the source of most of the disruptive events and where the need for

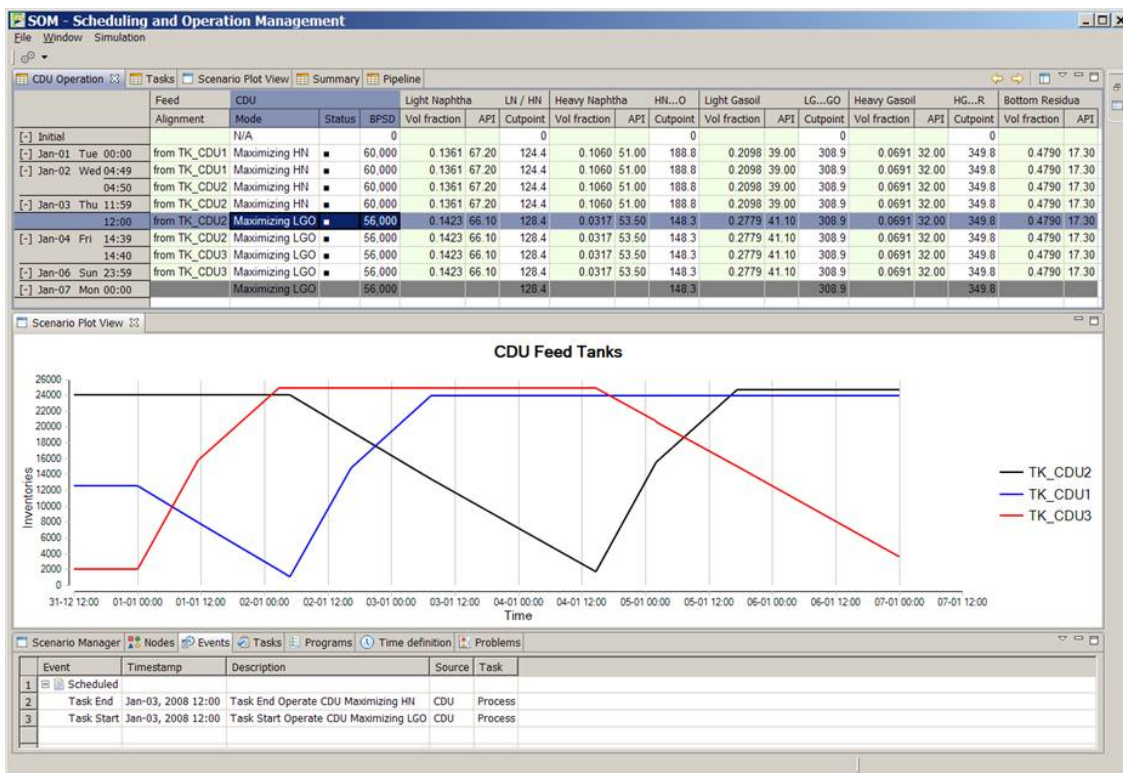
have many of those decision variables actually reaching those bounds.

Typically, operation managers will never plan to operate too tight against true operational constraints, especially those involving some sort of operational risk. Therefore the boundaries in the model for operations planning will be set to define a "comfort zone" for smooth operation rather than expressing the actual operational constraints.

However, in order to cope with unexpected events that disrupt the plan under execution, they will be

willing to expand the boundaries, even outside of their comfort zone, for short periods of time or to enable limited actions.

Adjusting operations by expanding operational boundaries in a limited and controlled way is a critical feature to support event management during execution. The models used to create an optimal



adjusting the schedule becomes a daily task.

When facing this sort of operational variability, experienced managers will try to take surgical actions to fix the on-going operations plan and put it back on track. Making a complete recreation of the optimal plan is not the right answer.

The model used to decide an optimal operations plan is not suited for making short-term adjustments to on-going operations. It is a model designed to capture the economical trade-offs by deciding on variables allowed to move within feasibility boundaries. Any optimal solution will

operations plan are too rigid to accommodate such flexibility. Even if the model already includes some parametric constraints that allow adaptation by the user, it is hard to anticipate where and when to expand a boundary in order to circumvent a problem unless you can simulate the scheduled operations under the new conditions to detect the infeasibilities and assess their magnitudes.

Thus, the model that was suited for deciding an optimal operations plan is unfitted for adjusting the short-term operation to support exception handling. But at the same time, proper analytical support is crucial to making the necessary corrections. These actions are meant to reduce the disruptions aiming

to keep “as close as possible” adherence to the targets, distributing the impact of the disruption among the many buffers that any rational plan does provide.

buffers along the process that can be used to reduce the deviations on those targets.

It is important that the underlying simulation model allows for temporal and localized relaxation of the

What a right tool should have

Once the plan is in execution, disruptive events do cause deviations to the planned targets. The longer the response time for a corrective action, the more difficult it is to return to the planned operations and the greater the benefit loss associated to the non-optimal operation is.

Automatic event detection provided by simulated operations is a key analytical support tool to perform efficient event management and achieve higher adherence level to planned targets.

By keeping an updated simulation of the projected state for all relevant control variables it is possible:

- to predict the occurrence of disruptive events and therefore to establish proactive actions minimizing further deviations
- to quickly and precisely analyze corrective actions to cope with the occurrence of events that were not anticipated
- to get visibility on the future effect of the corrective actions to be implemented, avoiding that today's solutions become disruptions short after

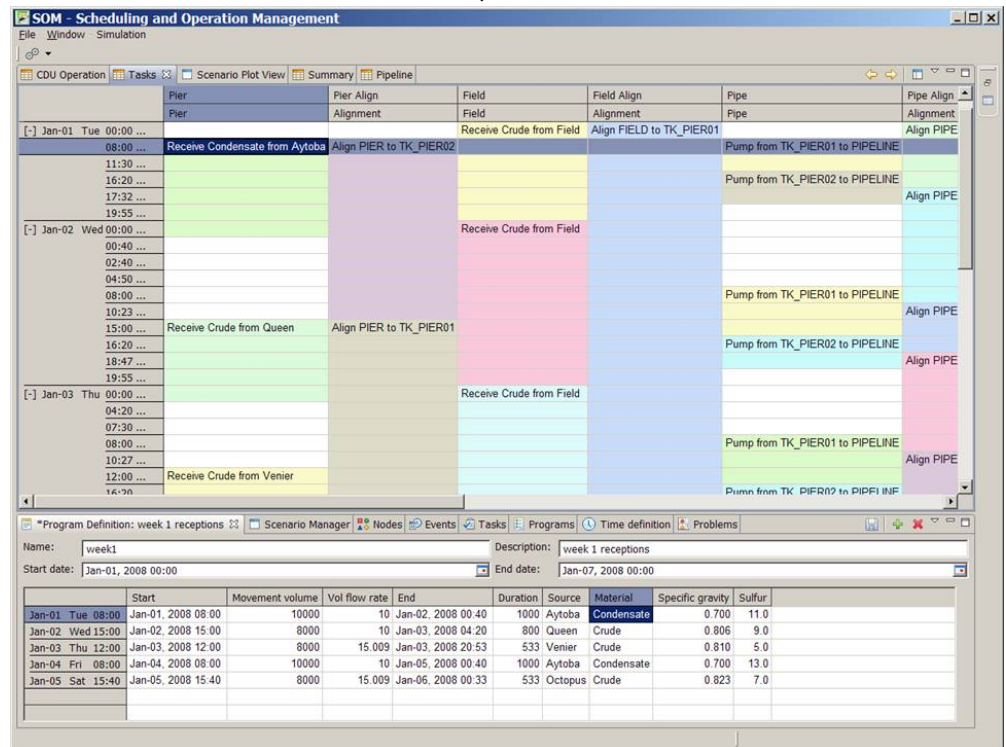
This requirement implies the ability to define controls and targets on critical state variables and firing simulated state events in case of deviation or constraint violations.

Another essential requirement is the ability to interpret the scheduled operations on terms of its targets and to effectively identify the location of

operational constraints. To help in the identification of those adjusting levers, it should be designed to allow the violation of constraints but provide a clear indication of the infeasibilities and the assessment of their magnitude.

The processes for capturing execution events, changes in the environment conditions, changes in resources availability and updates on the status of in-progress operations, should be fluently connected with the analytical model. The simulated projections should reflect any significant change by always keeping an updated outlook.

Managers should be provided with an agile environment for adjusting the operations plan and quickly assessing the impact of the changes. These changes should be analyzed on an integrated end-to-end model of the supply chain, reflecting the effects of every operations plan along the chain, even when they are managed by different responsible groups (e.g.: feedstock tank yard operation, plant operations, finished product shipping, etc.)



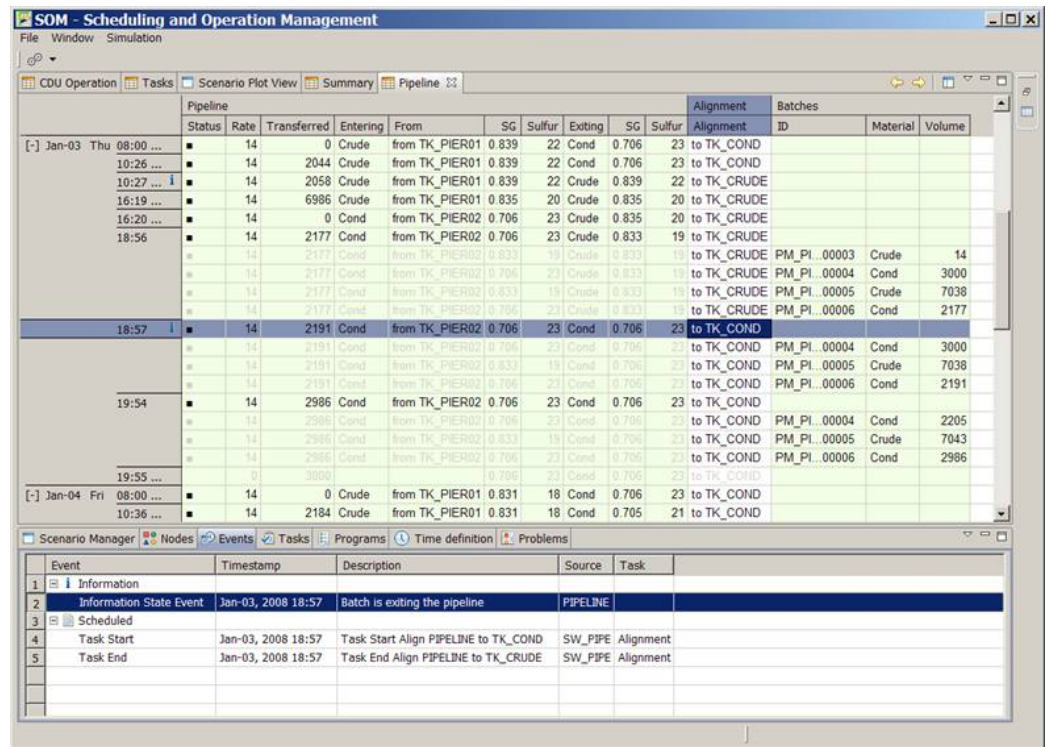
S-SOM Scheduling and Operations Management

S-SOM is an application based on hybrid continuous and discrete events simulations to support the management of operations in refinery and petrochemical processes that was originally designed to meet the requirements outlined above.

It provides future visibility through detailed simulation models of both logistic and unit operations, keeping constantly updated projections of inventories and material properties. These projections are automatically updated in the event of any modification of the operations plan or plant data, allowing the constant verification of the feasibility of the operations and assessing the schedule quality via performance indicators. The simulation engine is equipped with an automatic state event detection mechanism on control variables established by the user, which enables alerting on critical situations such as out-of-range levels and properties, material degradation by blending, etc.

S-SOM enables plant personnel to schedule and simulate operations on an integrated supply chain topological model. From the areas of feedstock reception, tank yards, ducts, through unit operation plants, to product shipment. The model includes all relevant equipment and their connectivity. In this way, the simulation of the scheduled operations automatically propagates their effects all along the supply chain, allowing the easy identification of possible imbalances between interdependent operations.

Managing scheduled operations through a systematic business process supported by effective analytical tools is crucial to achieve the benefits of optimized operations planning. In the refining and petrochemical industry this function currently appears as notoriously underdeveloped in comparison with the capabilities supporting advanced planning or advance plant control. As the supply chain becomes more integrated and globally managed, this process reveals its



SOM - Scheduling and Operation Management													
Pipeline													
Status	Rate	Transferred	Entering	From	SG	Sulfur	Exiting	SG	Sulfur	Alignment	Batches		
											ID	Material	Volume
[-] Jan-03 Thu 08:00 ...	14	0	Crude	from TK_PIER01	0.839	22	Cond	0.706	23	to TK_COND			
10:26 ...	14	2044	Crude	from TK_PIER01	0.839	22	Cond	0.706	23	to TK_COND			
10:27 ...	14	2058	Crude	from TK_PIER01	0.839	22	Crude	0.839	22	to TK_CRUDE			
16:19 ...	14	6986	Crude	from TK_PIER01	0.835	20	Crude	0.835	20	to TK_CRUDE			
16:20 ...	14	0	Cond	from TK_PIER02	0.706	23	Crude	0.835	20	to TK_CRUDE			
18:56	14	2177	Cond	from TK_PIER02	0.706	23	Crude	0.833	19	to TK_CRUDE			
	14	2177	Cond	from TK_PIER02	0.833	18	Crude	0.833	19	to TK_CRUDE	PM_PI_00003	Crude	14
	14	2177	Cond	from TK_PIER02	0.706	23	Crude	0.833	19	to TK_CRUDE	PM_PI_00004	Cond	3000
	14	2177	Cond	from TK_PIER02	0.833	18	Crude	0.833	19	to TK_CRUDE	PM_PI_00005	Crude	7038
	14	2177	Cond	from TK_PIER02	0.706	23	Crude	0.833	19	to TK_CRUDE	PM_PI_00006	Cond	2177
18:57	14	2191	Cond	from TK_PIER02	0.706	23	Cond	0.706	23	to TK_COND			
	14	2191	Cond	from TK_PIER02	0.706	23	Cond	0.706	23	to TK_COND	PM_PI_00004	Cond	3000
	14	2191	Cond	from TK_PIER02	0.833	18	Crude	0.706	23	to TK_COND	PM_PI_00005	Crude	7038
	14	2191	Cond	from TK_PIER02	0.706	23	Cond	0.706	23	to TK_COND	PM_PI_00006	Cond	2191
19:54	14	2986	Cond	from TK_PIER02	0.706	23	Cond	0.706	23	to TK_COND			
	14	2986	Cond	from TK_PIER02	0.706	23	Cond	0.706	23	to TK_COND	PM_PI_00004	Cond	2205
	14	2986	Cond	from TK_PIER02	0.833	18	Crude	0.706	23	to TK_COND	PM_PI_00005	Crude	7043
	14	2986	Cond	from TK_PIER02	0.706	23	Cond	0.706	23	to TK_COND	PM_PI_00006	Cond	2986
19:55 ...	0	3000			0.706	23	Cond	0.706	23	to TK_COND			
[-] Jan-04 Fri 08:00 ...	14	0	Crude	from TK_PIER01	0.831	18	Cond	0.706	23	to TK_COND			
10:36 ...	14	2184	Crude	from TK_PIER01	0.831	18	Cond	0.705	21	to TK_COND			

Scenario Manager				
Event	Timestamp	Description	Source	Task
1		Information		
2	Jan-03, 2008 18:57	Batch is exiting the pipeline	PIPELINE	
3		Scheduled		
4	Jan-03, 2008 18:57	Task Start Align PIPELINE to TK_COND	SW_PIPE	Alignment
5	Jan-03, 2008 18:57	Task End Align PIPELINE to TK_CRUDE	SW_PIPE	Alignment

weaknesses. The applications that are well suited to support the plan optimization are too limited to be effective in supporting event management and exception handling. A new breed of applications is emerging to boost the Operation Managers' capabilities for this task. Soteica's S-SOM was developed to address those requirements by design.