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# Approach to schedule automation utilizing SAIA by Idemitsu

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Company Name	<b>Idemitsu Kosan Co.,Ltd.</b>
Head Office	Chiyoda-ku, Tokyo, Japan
Representative Director & Chief Executive Officer	Shunichi Kito
Date Established	March 30, 1940
Capital Stock	JPY 168.3 billion
Net sales	JPY 8.7 trillion
Fiscal Term	From April 1 to March 31

# Company Overview: Main Business

## 2. Resources



## 1. Fuel Oil



## 3. Basic Chemicals



## 5. Electric Power & Renewable Energy



## 4. Functional Materials



# Company Overview: Manufacturing Base

6 Manufacturing Bases in Japan  
(Oil Refining & Petrochemical Plants)

CDU Capacity  
825,000 barrels/day  
Ethylene production capacity  
997,000 tons/year



**Tokuyama Complex**  
Ethylene 623k tons/year



**Aichi Complex**  
CDU 160kbarrels/day

**Showa Yokkaichi Sekiyu Co.,Ltd.**  
Yokkaichi Refinery  
CDU 255kbarrels/day

**TOA Oil Co., Ltd.**  
Keihin Refinery  
CDU 70kbarrels/day



**Hokkaido Refinery**  
CDU 150kbarrels/day

**Technology & Engineering Center**



**Chiba Complex**  
CDU 190kbarrels/day  
Ethylene 374k tons/year

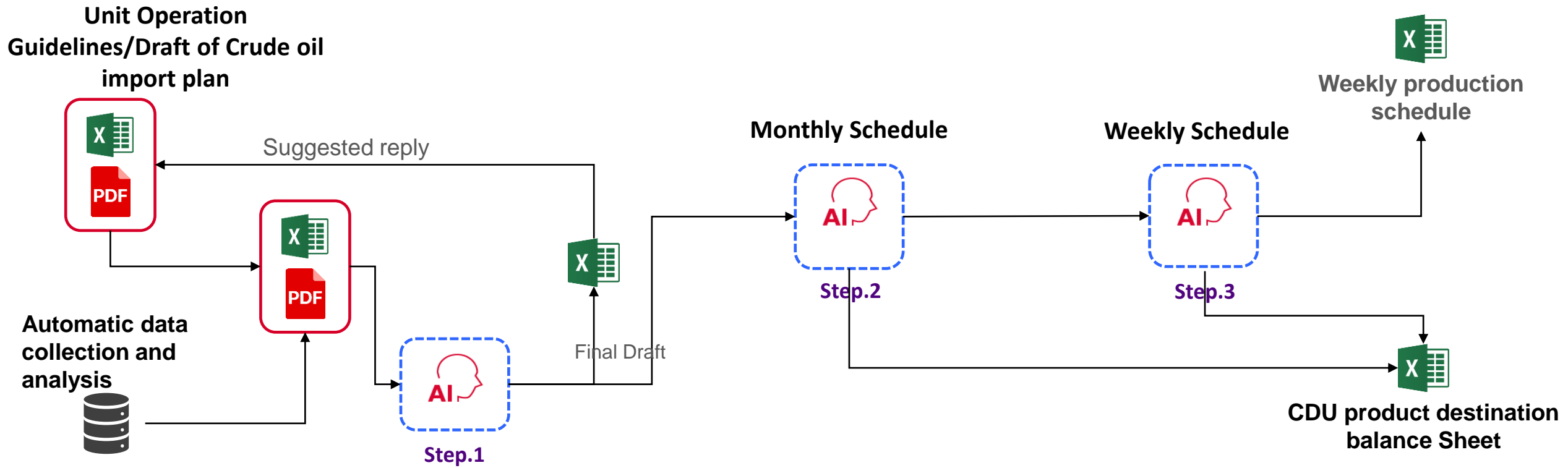
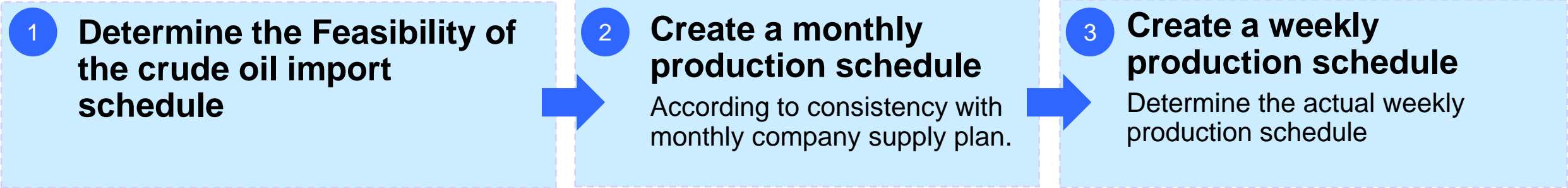
## 1. Background

- Production scheduling requires know-how related to operations, and great deal of knowledge and experience.
- Because the environment is changing rapidly, Schedulers are always focused on reviewing current schedules. So, they have no time to consider better schedule.

## 2. Purpose of SAIA

- In order to support the knowledge and experience , develop the function to automatically make optimal schedule, and reducing opportunity loss through rapid response.

# 03 Target State of the Production Scheduling system



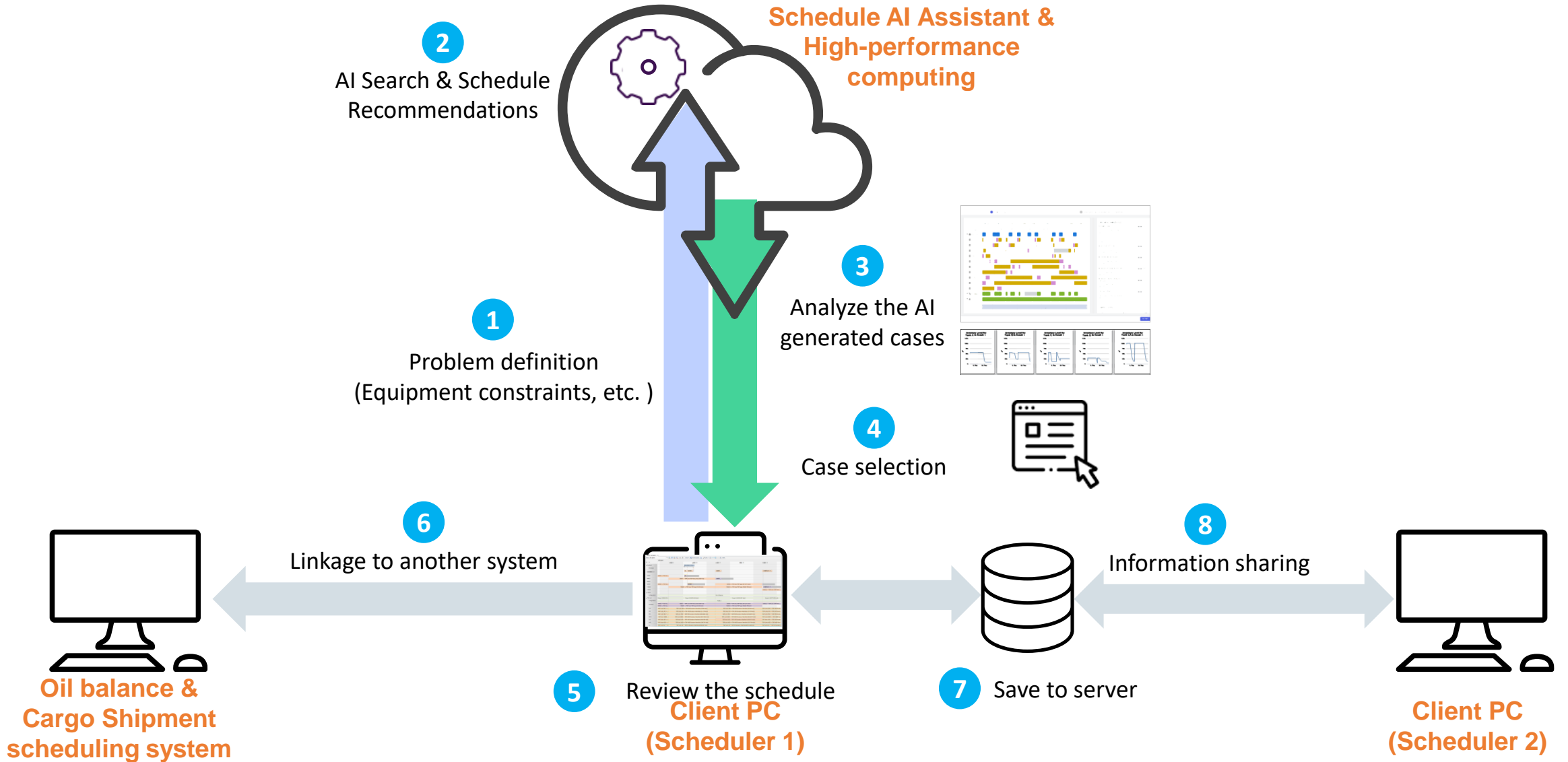
## 04 Implementation Schedule

Began updating each refineries to Spiral scheduler from 2017 and finished in 2021  
 In 2019 we began developing SAIA with AVEVA in parallel

	2017	2018	2019	2020	2021	2022	2023	2024
<b>Chiba site scheduler update</b>		Implementation	In use					
<b>Hokkaido site scheduler update</b>			Implementation	In use				
<b>Aichi site scheduler update</b>				Implementation	In use			
<b>SA Development</b>				Agile development & Implementation			In use	
<b>Chiba chemical Scheduler Implementation</b>				Implementation	In use			



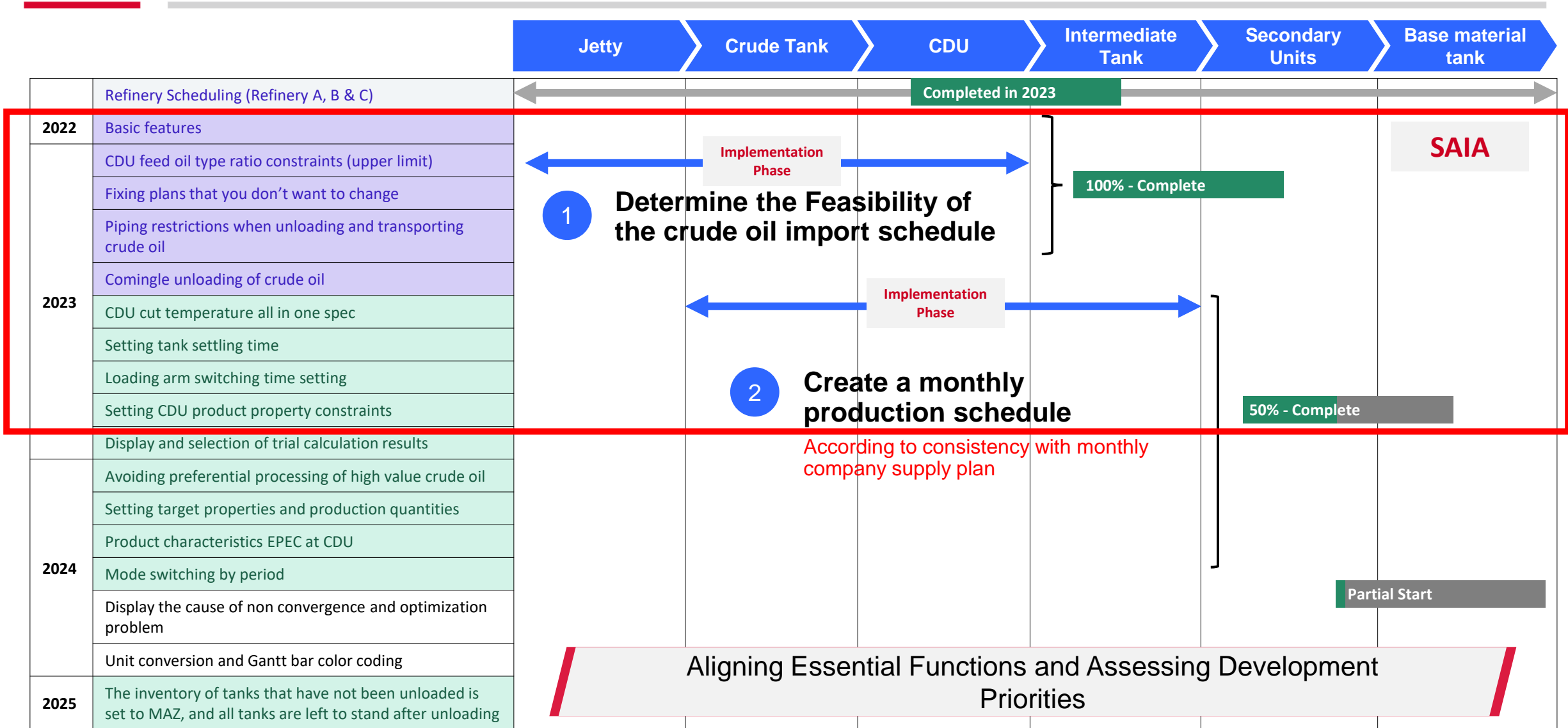
# 05 System Functionality



## Anticipated Benefits from the Schedule AI Assistant

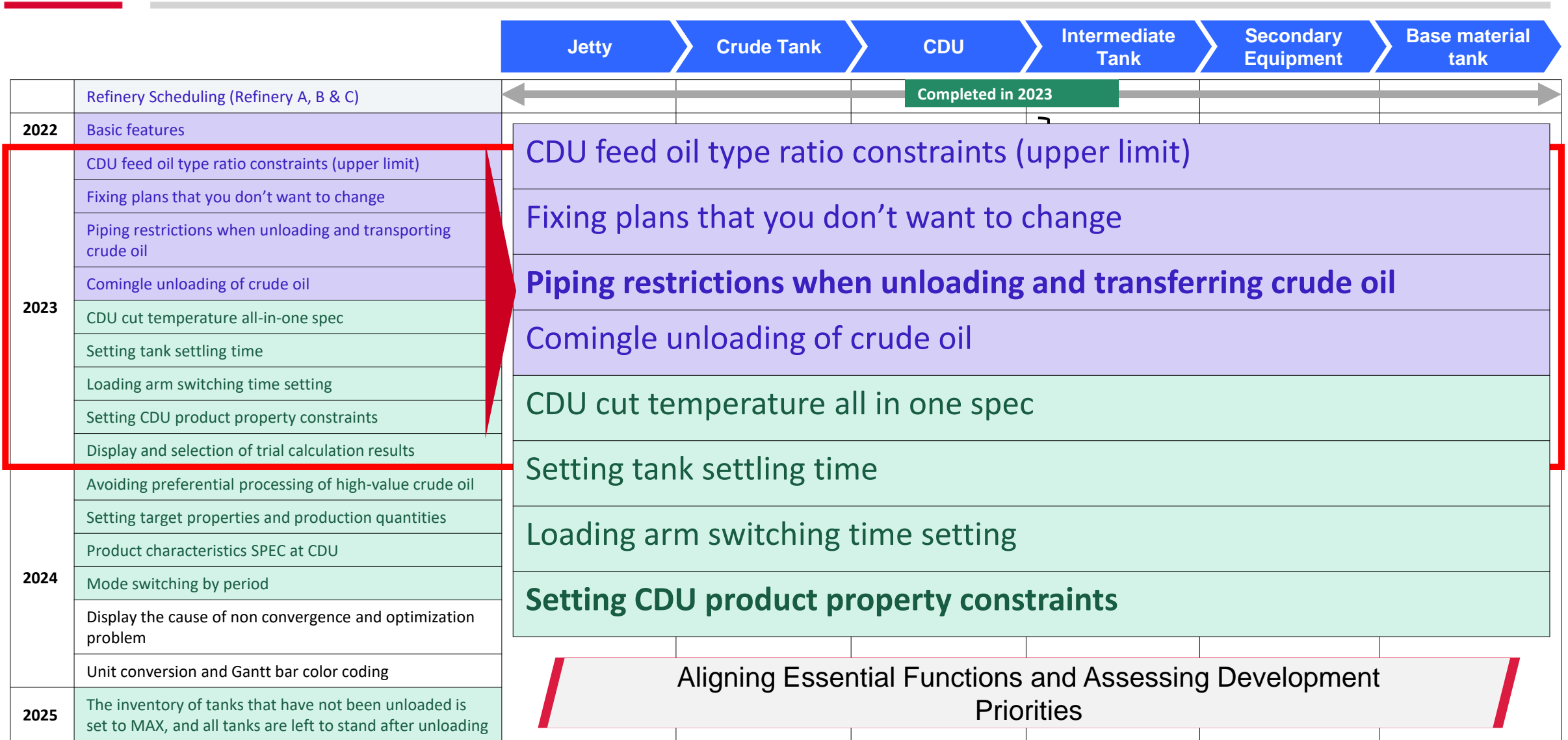
No.	Key considerations for AI Assistant	Anticipated Benefit
1	Reduced number of crude property changes	Reduced LGO leakage to Residue
2	Optimize the crude unload to tanks and from tanks to CDU taking into consideration the Residue properties	Switching to cheaper crude oil by making separate Residue for RHDS/VDU
3	Preventing surplus or off spec CDU products (from being converted into SLOP)	SLOP reprocessing cost reduction
4	Operation adjustments when trouble occurs	Reduction of demurrage fees and multiple port unloading for crude oil tankers (VLCC)
5	User configurable operating experience and constraints	Anyone can create schedules, even if they have no experience
6	Faster search and automated optimized schedule generation	Time to create one months' crude schedule from scratch

# 07 Implementation progress - Achievements



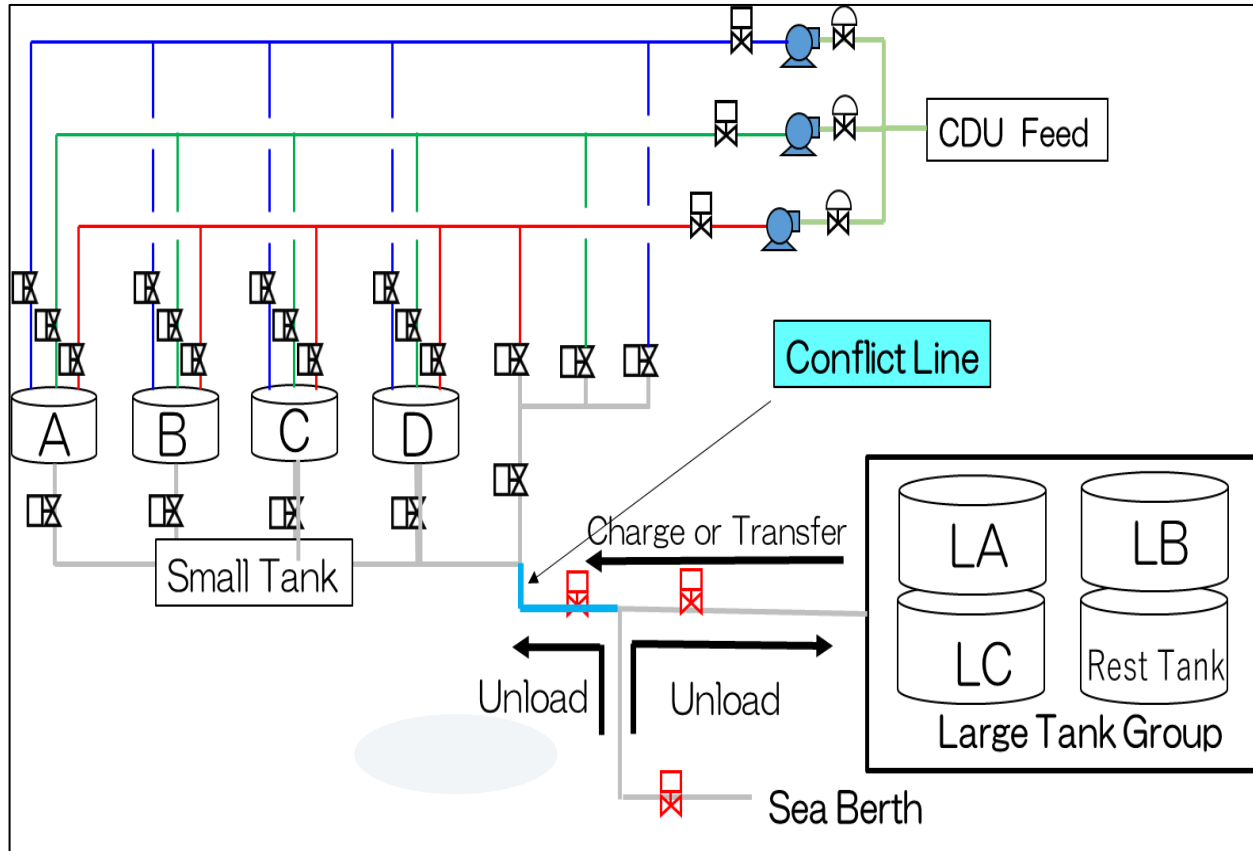
Aligning Essential Functions and Assessing Development Priorities

# 07 Implementation progress - Achievements



# Enhanced Scheduling: example of capabilities deployed & outcome

**Function 1:** Single use constraint setting (unloading pipe is also used for CDU feed line.)



Create groups of asset and lines and set exclusivity

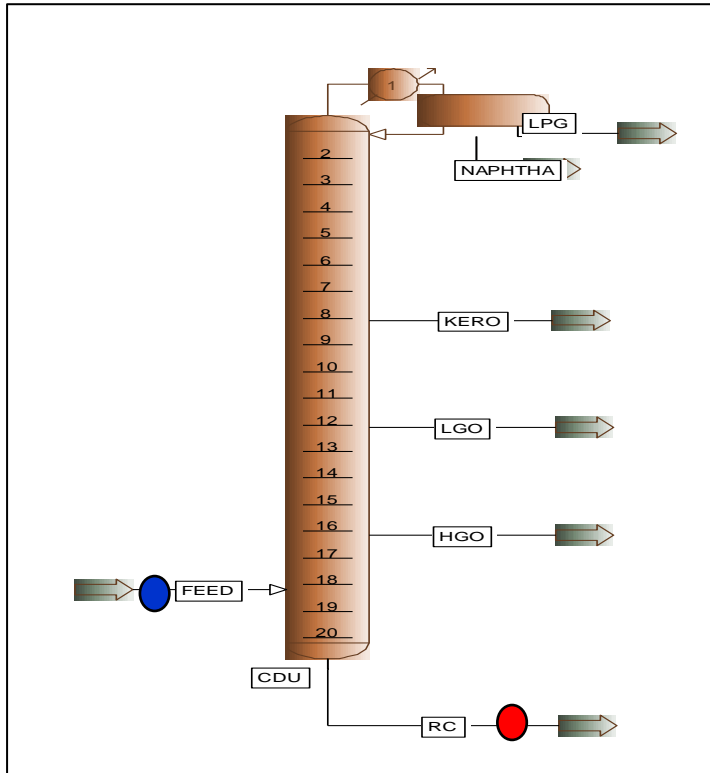
No.	Asset	Group	Line
1	Large Tank Group	Unload Line (Large Tank Group)	
2	Large Tank Group	Unload Line (small tank A)	
3	Large Tank Group	Unload Line (small tank B)	
4	Large Tank Group	Unload Line (small tank C)	
5	Large Tank Group	Unload Line (small tank D)	

No more scheduling infeasible combinations of supplying CDUs and unloading from ships

Helps in ensuring all operational constraints are considered while AI generates the recommendations

## Function 2: Allowable range of changes in feed and product properties when inflow changes

Example: Property changes in CDU feed ● and products ●



### Maximum Property Change

Apply maximum property change between adjacent events on an inflow stream

+ Create Maximum Property Change

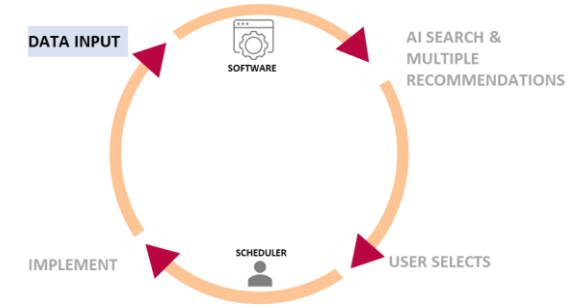
Title	Asset	Property	UoM	Editable	Value	Lower Limit	Upper Limit	Increment
<span style="color: red;">●</span> Residue Sulfer(%)	Sale for CDU Unit	Sulphur (Total) (%)		<input checked="" type="checkbox"/>	*	0	4	0.05 ...
<span style="color: blue;">●</span> CDU Feed API Change	CDU Unit	API		<input checked="" type="checkbox"/>	*	1	4	0.1 ...

Improves stability and efficiency of CDU operations

### Function 3: Setting minimum duration for activities

**Example:** Minimum duration before switching CDU feed conditions

- Feed tank change
- Feed tank ratio change
- Feed amount change

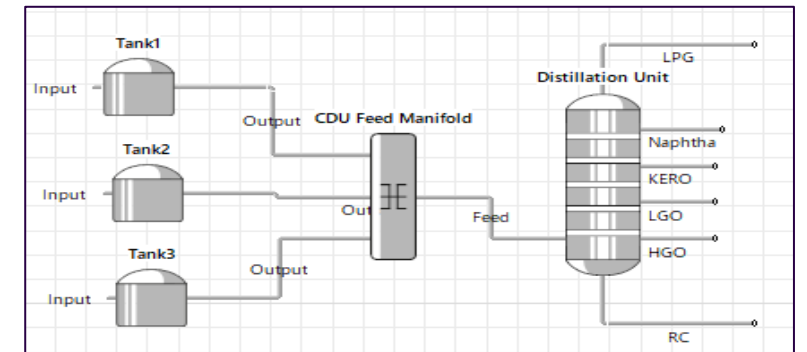


This makes it possible to minimize the effort required for switching crude oil and product loss

### Function 4: Setting facility input/output constraints

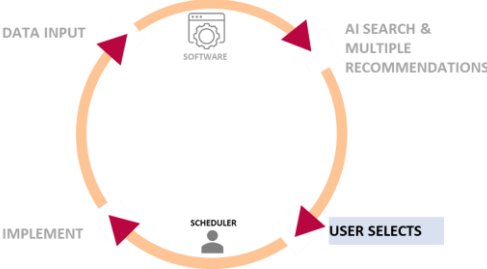
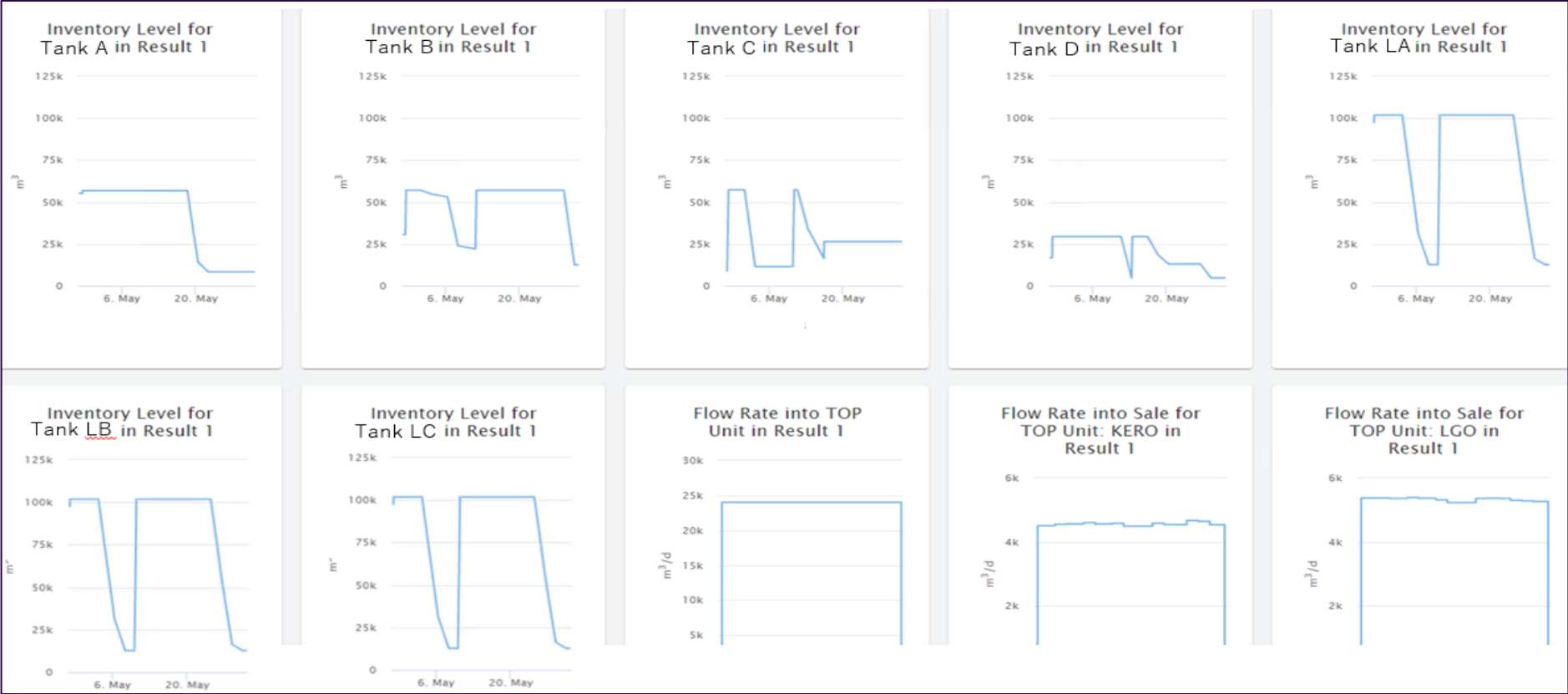
Set constraints on the supply to and output from the equipment.

**Example:** Setting constraints on maximum number of feed tanks that can be lined up for processing in CDU



Helps in ensuring all operational constraints are considered while AI generates the recommendations

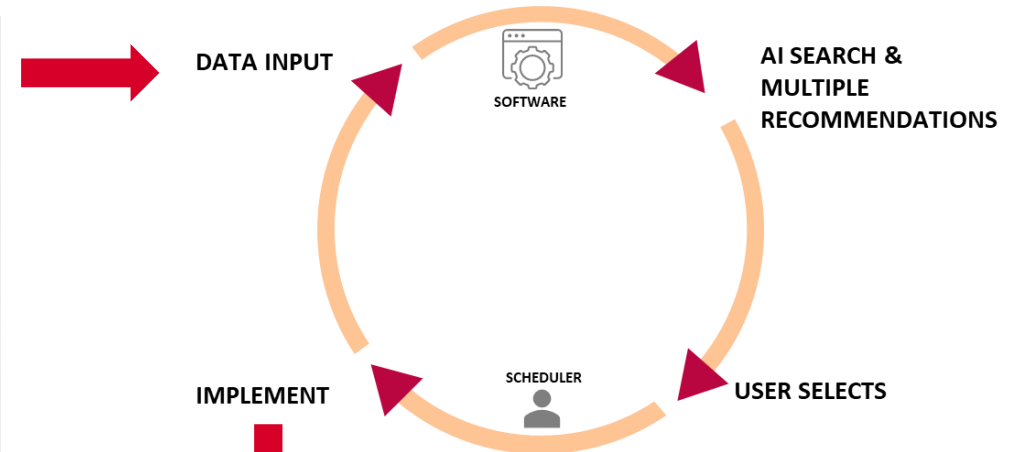
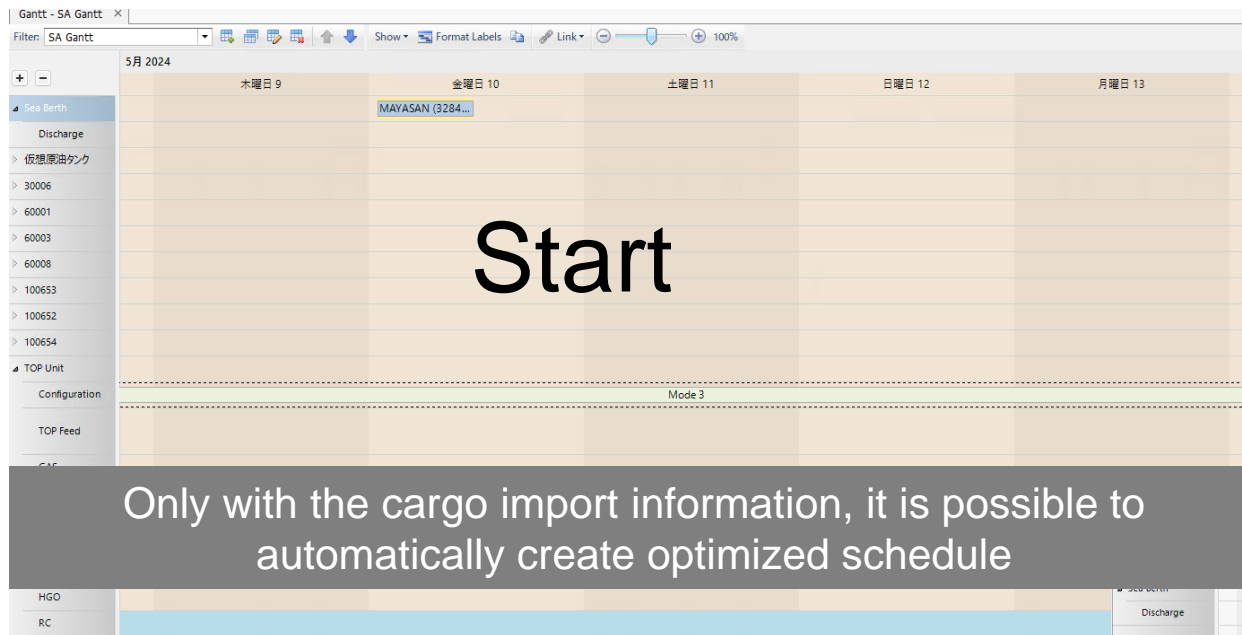
# Function 5: Reviewing the results of the AI recommended schedules



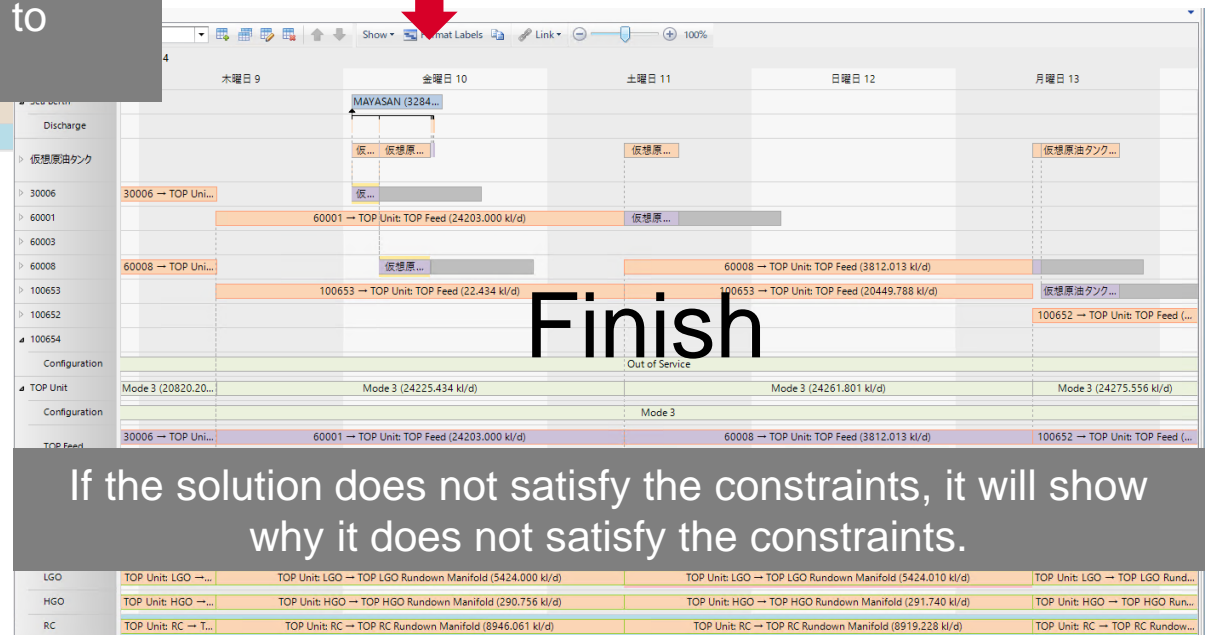
Helps in faster review and selection of schedule to be implemented



# 09 Validation: Crude Schedule generation



**Rapid Schedule Generation**



# 10 Path Forward: Blueprint for Success



Year	Requirements	2024	2025
2022	Refinery Scheduling (Refinery A, B & C)	2024	2025
2022	Basic features		
2023	CDU feed oil type ratio constraints (upper limit)		
	Fixing plans that you don't want to change		
	Piping restrictions when unloading and transporting crude oil		
	Comingle unloading of crude oil		
	CDU cut temperature all-in-one spec		
	Setting tank settling time		
	Loading arm switching time setting		
	Setting CDU product property constraints		
Display and selection of trial calculation results			
2024	Avoiding preferential processing of high-value crude oil		
	Setting target properties and production quantities		
	Product characteristics SPEC at CDU		
	Mode switching by period		
	Display the cause of non convergence and optimization problem		
	Unit conversion and Gantt bar color coding		
2024	The inventory of tanks that have not been unloaded is set to MAX, and all tanks are left to stand after unloading		
2025	The inventory of tanks that have not been unloaded is set to MAX, and all tanks are left to stand after unloading		

Prioritizing requirements with an Agile deployment approach:  
Maximizing immediate benefits from newly developed features

# Transforming Schedule Operators to Value Chain Strategists



## Challenge

- Environment (Operations and Market) changing so rapidly, focus is on reviewing current schedules
- No time to search for better and optimal operational schedules

## Solution

- Partnership approach with AVEVA, developed and deployed AVEVA's Schedule AI Assistant (SAIA)
- Gradually digitized the operating experience, knowledge and constraints - equipment and operational, that are easy to configure and requires no coding

## Results

- Rapid AI assisted Crude scheduling (from receipts to CDU operation) while considering unique operating complexity and constraints
- What would have taken days of work can be completed in few minutes with increased business agility and improved profits by optimized decision-making
- Currently work in progress on automated monthly production schedule generation



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**Thank you for your attention.**

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