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AVEVA Process Optimization: Tips for Advanced Users

More value from online systems

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AVEVA

- Agile LP Vector Generation (*REPSOL*)

- Introductions
- APO installed base: *Leverage Online Models*
- Challenge: *Reconsider the process*
- Objective: *Simple, Adaptable, & Appropriate*
- Solution: *Automated and Understandable*
- Summary: *Benefits & Conclusions*

*Nice extension of online modelling for more value
(remember all models are approximate)*

- New Interfaces (works in progress)

- APO application home page: *centralized access*
- Object based Excel xll add-in: *simplifies getting the answer to “what-if”*
- EDI via web-API with proof-of-concept Excel: *leverage update to improve work process*
- Solution analytics and explainer: *Move to presenting answers rather than tools*

Fit-for-purpose interfaces to improve efficiency



Agile LP Vector Generation from RTO at Repsol

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Presenting:

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Agenda

Introduction

Repsol

APO installed based at Repsol

Challenge

Objectives

AVEVA Solution

Benefits & Conclusion



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Introduction



Repsol

We are a global multi-energy provider working to drive the evolution towards a low-emissions energy model.

- Global multi-energy company: We are present throughout the entire value chain and market a wide range of products in 100 countries worldwide.
- Net zero emissions: We are leading the energy transition by being the first company in the energy sector to set the goal of reaching net zero emissions by 2050.
- Innovation: We have launched more than 280 digital initiatives to improve efficiency and safety and optimize resources.
- A talented team: We have a diverse team of more than 24000 employees representing 70 nationalities who work across 30 countries.

Introduction

APO Installed base at Repsol

- Repsol have APO installations as RTO in all their refineries
- There are CDU + VDU RTO close-loop applications, conversion units (HCK and HDT + FCC) RTO closed loop applications and refinery-wide Utilities RTO open-loop applications.
- In total there are 6 close-loop applications and 2 open-loop applications (Utilities) commissioned and 2 new applications under development. 3 of them include LP Vector generation functionality.

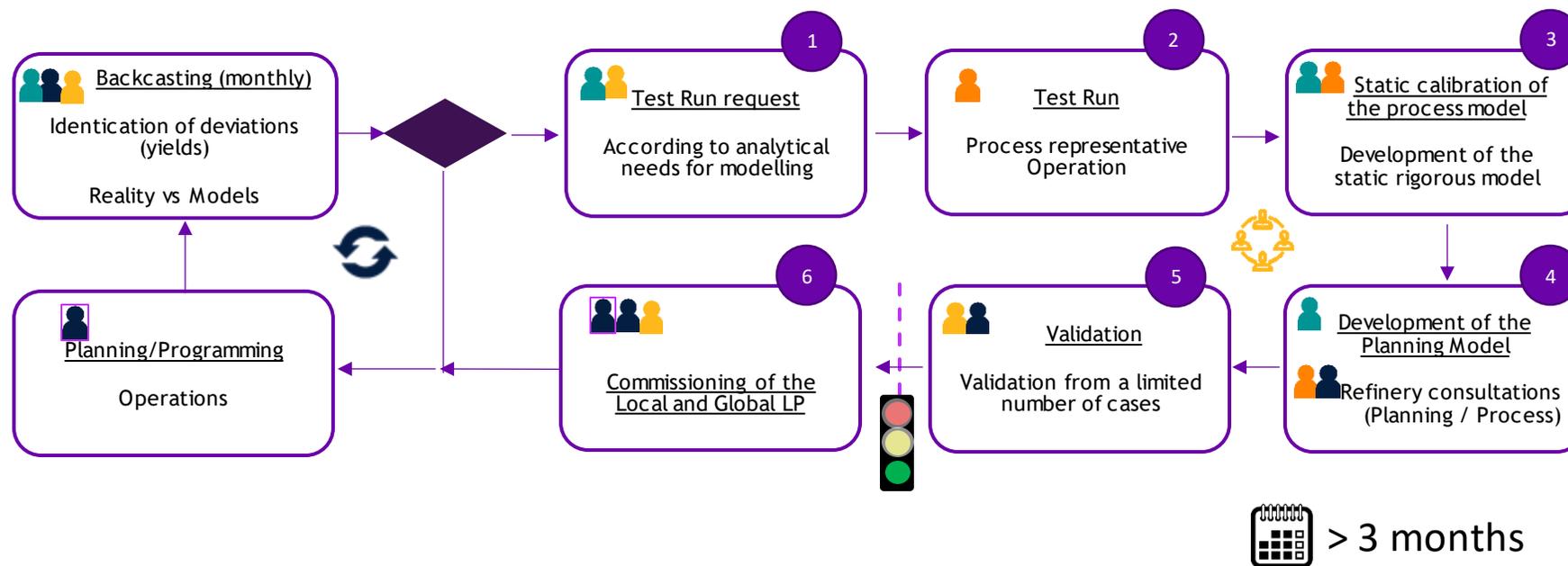


Challenge



Background: Repsol Previous Procedure for LP Vector Generation

Obtaining reliable production plans and programs depends on matching the simulation models of the refinery units with reality.



Planning



Programming/
Production
Optimization



Refinery
(Process/
Operations)



UCM



Technology Lab

Challenge



Background: traditional procedure drawbacks

1. It requires a program of test-run execution to collect healthy data for vector calculation
2. It requires to Operations Department to keep constant feed and smooth operation for several cases.
3. It requires mobilization of resources from Lab, Operations, Technology, Planning,...
4. It is very time consuming of the different resources: several weeks to obtain new LP Vectors
5. It requires model development and maintenance specifically for LP vector generation, this is normally done by Technology group (a group that is not located in the refinery).
6. It is not possible to cover all the operation modes and situations (catalyst cycle life) with just Test runs.

Objectives



Agile LP Model Updates

- The objective is to develop a tool that allows monitoring the variables of the process automatically and calculate the performance vectors and characterization of the productions in an **agile** way and with less effort.
- The agile procedure must be accompanied by a comprehensive visualization of the quality of the generated LP vectors that allows comparison with reality and selection of the generated LP vector that best fits reality.

AVEVA Solution



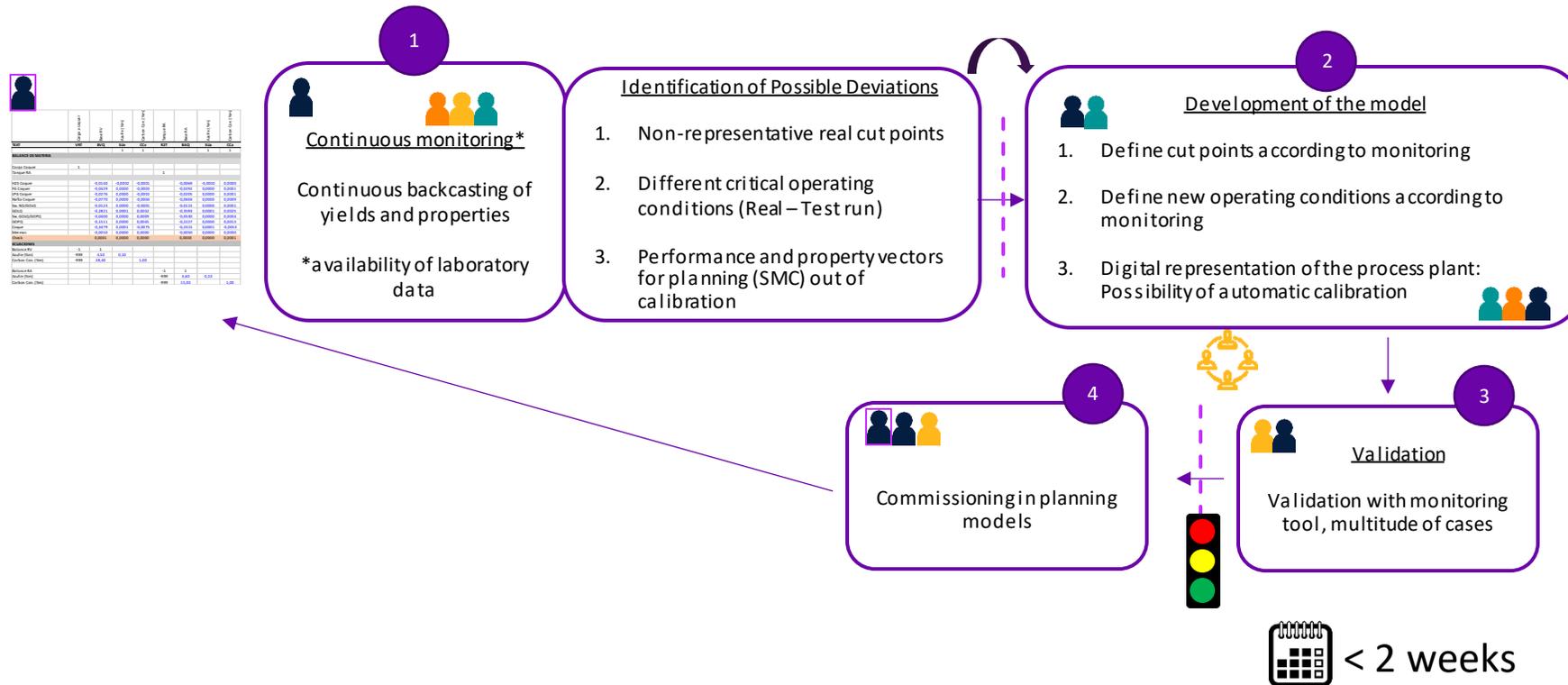
AVEVA RTO

- AVEVA RTO model and infrastructure includes all the necessary components to generate accurate LP vectors in a frequent and automatic way.
- AVEVA RTO continuous generated data allows the selection of the most accurate plant data for LP vector generation minimising the risk of unpredicted factors in the test-runs.
- AVEVA RTO continuous monitoring allows detecting changes in the behaviour of the main units due to the catalyst cycle, operational changes, etc. and being able to update the unit LP models with greater precision and frequency: product performance and quality

AVEVA Solution



Current LP Vector Generation Procedure at Repsol with AVEVA RTO



Unit	Crude Input	Crude Output	Crude Loss	Crude Yield	Crude Conversion	Crude Efficiency	Crude Quality	Crude Quantity	Crude Value
Crude Input	10000	10000	0	100%	100%	100%	100%	100%	100%
Crude Output	9500	9500	500	95%	95%	95%	95%	95%	95%
Crude Loss	500	500	500	5%	5%	5%	5%	5%	5%
Crude Yield	9500	9500	500	95%	95%	95%	95%	95%	95%
Crude Conversion	9500	9500	500	95%	95%	95%	95%	95%	95%
Crude Efficiency	9500	9500	500	95%	95%	95%	95%	95%	95%
Crude Quality	9500	9500	500	95%	95%	95%	95%	95%	95%
Crude Quantity	9500	9500	500	95%	95%	95%	95%	95%	95%
Crude Value	9500	9500	500	95%	95%	95%	95%	95%	95%

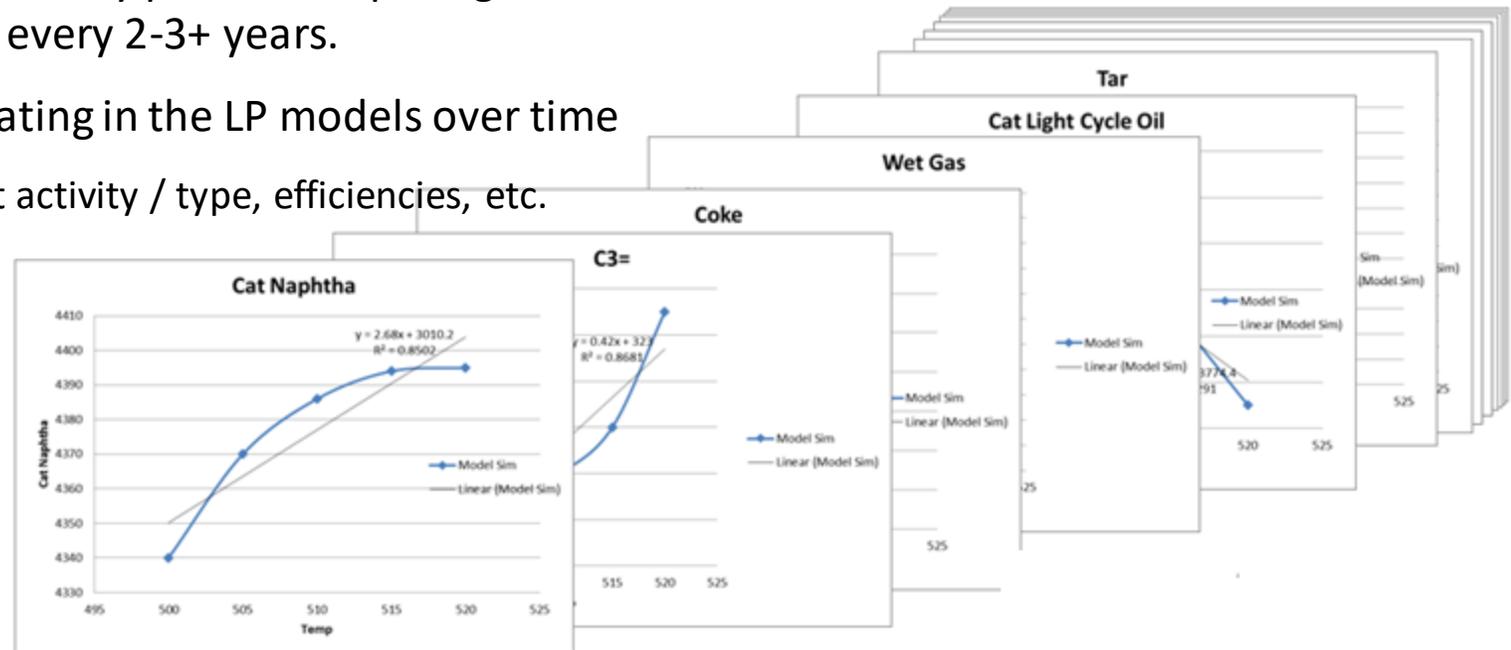
Planning
 Programming/Production Optimization
 Refinery (Process/Operations)
 UCM
 Technology Lab

AVEVA Solution



Background: LP Update Usual Procedure

- Closed-form models are used to run hundreds of parametric cases, varying one independent variable at a time to simulate the response of all dependent variables, then regress the large amount of data to obtain the LP gains
- Due to the closed-form nature of models, the plant control relationships are not accurately reflected in the LP gains, making regular LP validation difficult, and introducing additional inaccuracies into the LP predictions
- Because this is such a time-consuming and costly process, requiring weeks/months of work to re-correlate the LP gains, such updates are made once every 2-3+ years.
- For this reason inaccuracies start accumulating in the LP models over time
 - Due to shifts in unit operating points, catalyst activity / type, efficiencies, etc.

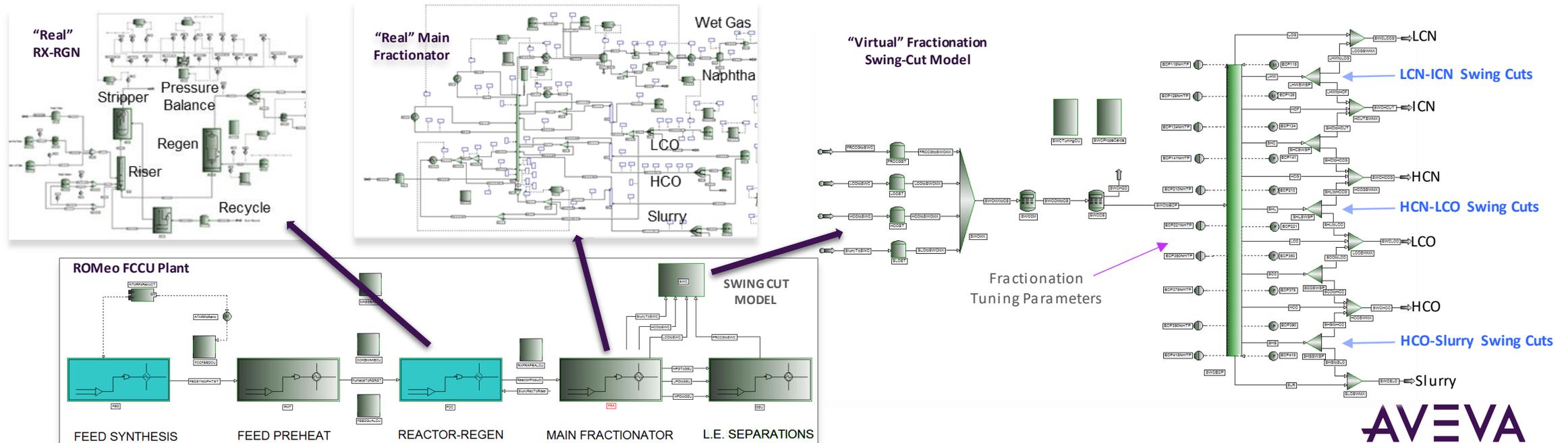


AVEVA Solution



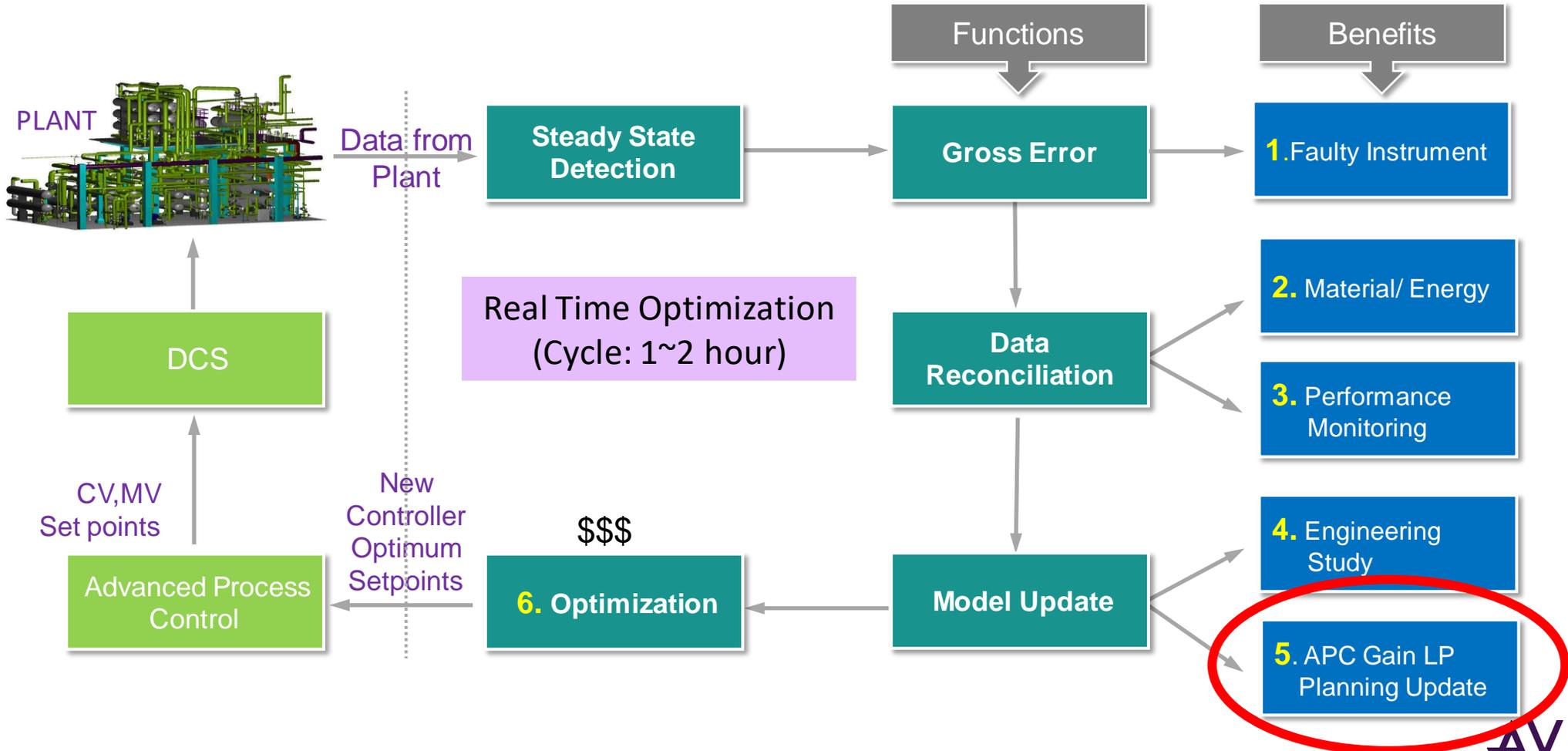
Model Includes the Scope of the “Real” Plant, and also a “Virtual” Plant Needed for LP Gains

- The “Real” plant model covers the full and detailed scope of the actual process unit
 - Feed characterization, reactor unit geometry/catalyst, product fractionation, product qualities, process control strategies
 - This degree of model fidelity ensures the model uses all key process measurements to tune the model correctly
- The “Virtual” product fractionation model calculates gains the planning LP needs to optimize product cut-points
 - Called “swing cuts”, they are that portion of a side-stream that can be cut into a lighter or heavier product stream
- The DataRec tuning strategy ensures the “Virtual” model correctly predicts “Real” process unit responses for yields and qualities
 - Product yields and qualities (SpGr, Distillation, ...) must be the same between “Real” and “Virtual” models



AVEVA Solution

Fits in the AVEVA Real Time System – fully automatic LP generation



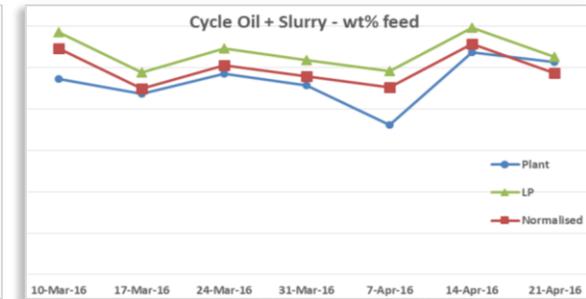
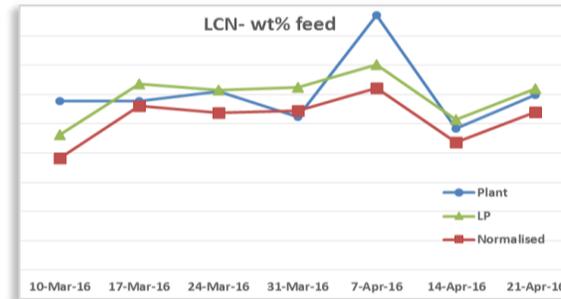
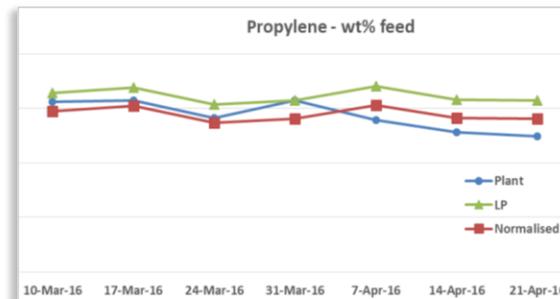
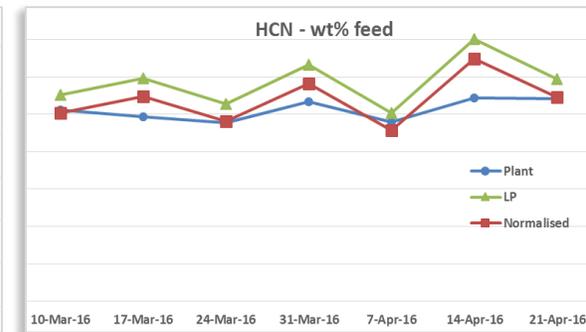
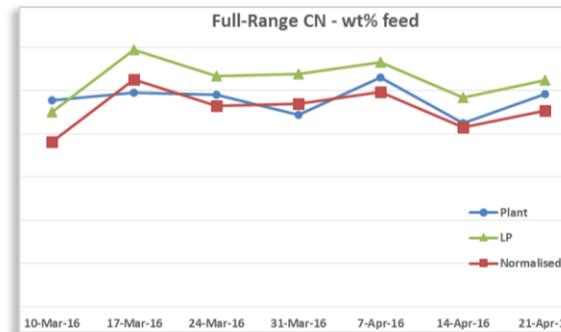
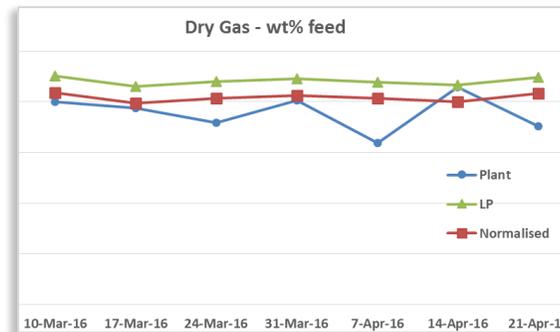
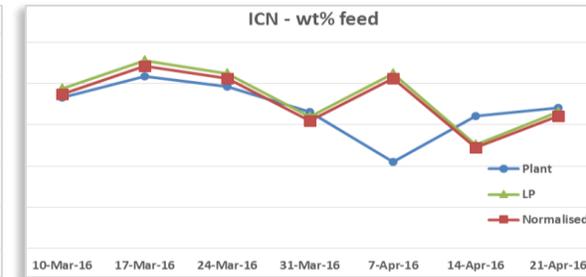
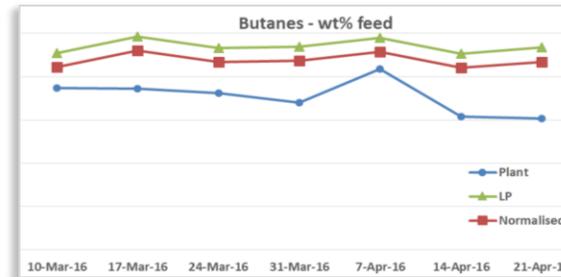
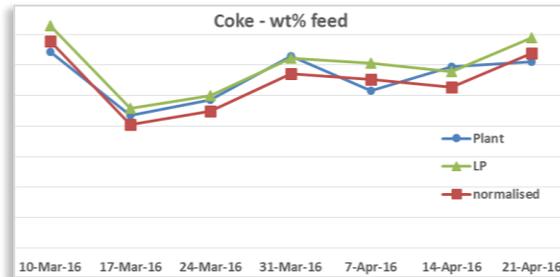
AVEVA Solution



Planning LP Updates Triggered by LP Accuracy Monitoring

- **LP Validation Tool:**

- An Excel sheet with the LP sub-model and latest ROMEo gains, linked to plant data
- Plant data is imported for all “Cause” and key “Effect” variables, to compare LP predictions to actual plant trends
- “Cause” variables are feed properties (CCR, Dist., SG, Ni, V, ...), RX operating conditions
- “Effect” variables are yields, key properties
- Recent plots show good agreement of LP vs. actual plant yields – can continue using the current LP gains!
- When deviations start increasing, it’s time to update the LP gains using the ROMEo model.
- Tool allows the selection of most accurate LP vector automatically.



Project Implementation



Implementation experience at Repsol

- Main challenges of LP Vector generation implementation at Repsol:
 - RTO and planning groups at the refinery are different groups with different necessities and approaches.
 - The plant scope for the RTO model and the LP model may be slightly different.
 - The mass balance calculation of the LP model uses different assumptions from the RTO mass balance.
 - The performance testing takes long due to the nature of the planning work process: it requires back-casting to assess the accuracy of the model at the end of each month.
- Key Points for Success:
 - Close collaboration between the AVEVA team and the Repsol planning team.
 - Project execution flexibility to consider that the performance assessment may take extended time due to the nature of the planning work process.

Benefits & Conclusions



- Very agile automatic LP vector generation that allows vector review and change on a monthly basis.
- Reduce of the cost of the LP Vector generation to a few hours of a planning engineer.
- The RTO model generates the LP vector so maintenance is included
- The data generated by the RTO substitutes the test-run.
- Early detection of LP prediction deviations.
- Continuous LP vector generation in all different actual operation modes and situations.

Questions?

Please wait for the microphone.
State your name and company.



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Navigate to this session in the mobile app to complete the survey.



Thank you!

New Interfaces

for Improved Marginal Returns

APO application home page: *Centralized access*

Object based Excel xll add-in: Answering “what-if”

EDI via web-API: *leverage to improve the work process*

New fit-for-purpose interfaces to improve efficiency

Solution analytics and explainer:

Presenting answers rather than developing tools

Will distribute video demonstrations through Global
Customer Support Web-site by year-end

★ APO application home page

APO Optimization Monitor - Centralized access to results and new functionality

- Web based application health monitoring across a corporate network
 - Typical tracking of measurement errors, objective functions, constraints, robustness, etc.
- Visualization for understanding (not a competitor to historians)
 - Performance trending, performance monitoring, stream factors, equipment KPIs
- Centralization of access to new tools (mostly version independent)

- Status
 - Responding to feedback from beta, updates in progress, will release in Q4

★ AVEVA Process Optimization: “What-if” landing page

Centralized repository of template worksheets

AVEVA™ Process Optimization

Search, Notifications, Help, Profile, Grid icons

Data Models								
Workbooks	7	Ok	HYP_Excmp_Case_Template.xlsx	HYP	T1ECSD - Train 1 Exp Recompr down - - T1HYSD - Train 1 Hi Yield Plant dow...	Prasad Patgaonkar	27/Apr/2022	
	8	Ok	LGComp_Case_Study_Template.xlsx	new	LGCSSD Tr-S Lean Gas Compr down -- LGCSD Tr-AS LGC down Without Tr-2...	Prasad Patgaonkar	27/Apr/2022	
	9	Ok	LPIP_Feed_Compressor_Template.xlsx	none	T1LPIPSD - Train 1 Low/Intermediate P feed Compr Shut Down --...	Prasad Patgaonkar	27/Apr/2022	
Admin	10	Ok	NGL_Pump_Template.xlsx	none	NGLPMPSD - NGL Pump Shut Down -- T1NGLSD- Train 1 NGL Pump Shut...	Prasad Patgaonkar	27/Apr/2022	
API	11	Ok	BuHasaExcelExample	Demo,Compressor shutdown,Equipment shutdown,Feed compressor	Sample Excel Workbook	Joe Kovach	14/Jul/2022	



AVEVA Process Optimization: Data Models landing page

Centralized management and qualification of databases

AVEVA™ Process Optimization

Search, Notifications, Help, Profile, Grid icons

Data Models

Filter, New Model

Id.	Status	Name	Keywords	Description	Creator	Created Date	Actions
5	Ok	GoodSolved_2019-10-15	Balanced trains,600 MMSCFD,Standard unit lineup	2022.04 model regressed with data from 2019.10.15 at 20.20, total feed i...	Navya Mergu	27/Apr/2022	
6	Ok	BuHasaExcelExample	unknown	online master model from 2021.10.	Navya Mergu	27/Apr/2022	

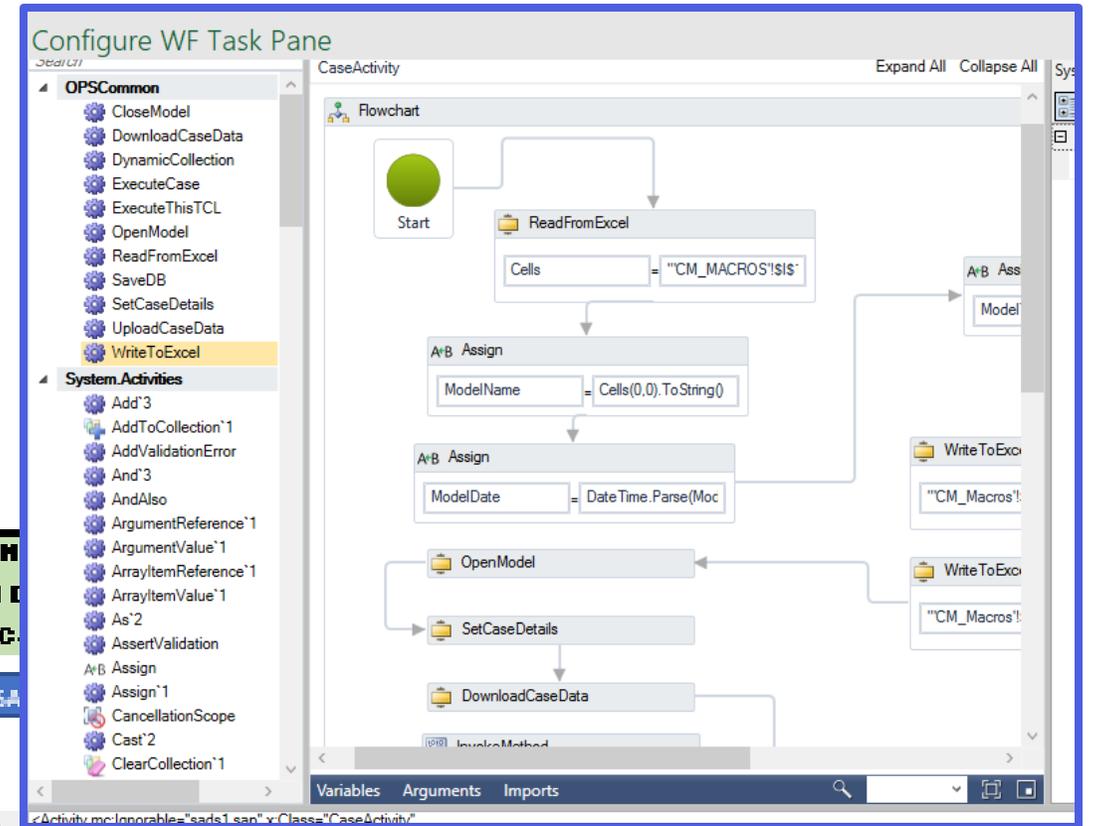
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Workbooks, Admin, API, <

Example of Excel “What-if” Workflows

tonm/hr	Balance	-116.10	-116.10	tonm/hr	Model Name
%	%	-16.51	-16.51	%	Selected Case

Get Default data	Run ASAB-2 141 SD case	Macros	ASA
Run BGC 191 SD case	Run ASAB-2 241 SD case		
Run BGC 291 SD case	Run Div Gas Compr SD case	Run ASAB-1 & 2 SD case	Run ASAB-1 Feed cut case
Run Stab 122 SD case	Run RGC 196 SD case	Run AGC 153 Tr-A SD case	Run ASAB-03 Feed cut case
Run Stab 222 SD case	Run RGC 296 SD case	Run AGC 153 Tr-B SD case	Run A0 EX/RC SD case



Excel "What-if" Overall Flowsheet and Data sheets

OVERALL SCHEMATIC For XXXX

TOTAL HP FEED COMPOSITION

Cl	10.15	10.15	percent
CC	10.15	10.15	percent
CC2	8.24	8.24	percent
HC4	1.67	1.67	percent
CC4	1.49	1.49	percent
CC5	0.78	0.78	percent
HC5	0.75	0.75	percent
CC6	0.48	0.48	percent
CC7	0.18	0.18	percent
HC7	0.88	0.88	ppm
CO2	0.36	0.36	percent

TOTAL IP FEED COMPOSITION

Cl	10.17	10.17	percent
CC	10.17	10.17	percent
CC2	10.18	10.18	percent
CC3	9.93	9.93	percent
CC4	4.94	4.94	percent
CC5	2.93	2.93	percent
CC6	3.44	3.44	percent
CC7	0.85	0.85	percent
CC8	0.12	0.12	percent
CC9	0.83	0.83	percent
CO2	0.36	0.36	percent
HC2	0.88	0.88	ppm
HC3	0.88	0.88	percent

TOTAL LP FEED COMPOSITION

Cl	10.17	10.17	percent
CC	10.17	10.17	percent
CC2	10.18	10.18	percent
CC3	9.93	9.93	percent
CC4	4.94	4.94	percent
CC5	2.93	2.93	percent
CC6	3.44	3.44	percent
CC7	0.85	0.85	percent
CC8	0.12	0.12	percent
CC9	0.83	0.83	percent
CO2	0.36	0.36	percent
HC2	0.88	0.88	ppm
HC3	0.88	0.88	percent

ASAB-03 Mass Balance Cleaner

Total Feed	144.51	144.51	mass/hr
BP FEED	144.51	144.51	mass/hr
IP FEED	144.51	144.51	mass/hr
LP FEED	144.51	144.51	mass/hr
ABCO-T1	144.51	144.51	mass/hr
ABCO-T2	144.51	144.51	mass/hr
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ABCO-T8	144.51	144.51	mass/hr
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ABCO-T97	144.51	144.51	mass/hr
ABCO-T98	144.51	144.51	mass/hr
ABCO-T99	144.51	144.51	mass/hr
ABCO-T100	144.51	144.51	mass/hr

22 Default /ASAB-03/AU3CnIIDownandDemethanizer/24F14540 FALSE FALSE FALSE FALSE

~WFDefn ~InputConfig ~Data ~OutputConfig CM_MACROS ASAB-03 ASAB-1 ASAB-2 Overall_Case Reinj Comp Booster Comp (+)

Diagnostics



Excel / Web API

Primary use case: “What-if” analysis (all solver modes) in an RTO plant environment

- Robust to changes in Excel layout
- Macros in Excel improve compatibility as models evolve
- Size is only limited by Excel – have run with thousands of tags
 - Slow on retrieval but display responds within seconds
- Version independent, COM/DCOM or Web API (local vs web)
- Streaming diagnostics for model status
- Used on several projects, development is ongoing

★ EDI via Web-API:

AVEVA Process Optimization 2022 and later

- Persistence is Text Based
- It is accessible independent of the MAServer and Real Time System
- Exploring Alternate Interface – Excel Proof-of-Concept to understand use cases
 - Edit file in Excel, export to text, EDI in the MAServer or RTS will update according
 - Data can be accessed from the Excel through the Web-API or browser-based tools
 - Deploys independent of Process Optimization for pre-release testing and support
- Next step, solicit input:
 - for “measurement functionality” in EDI and purpose-built GUI for configuration

★ Solution Analytics and Explainer

Comments only

- Long term effort with the ultimate goal being a report stating “why it did what it did”
- Interim solution is a tool for investigation that produces understanding
- Analytics is undergoing review with customers and subsequent revisions
 - Review consists of using the tool for a problem investigation, the customer learns the technology, development learns the characteristics of the problems and by observation, better ways to meet requirements – it is an ongoing process
- Important points: Solution Analytics is mostly independent of the APO version. Some modes execute completely independent of the server. Most new functionality does NOT require changes to the MAServer or the Solver.

★ Summary

- Video demonstrations through Global Customer Support Web-site by year-end
- Input on specific topics such as the best way to solicit and collect feedback, organization of material, depth of technical discussion, use and possible distribution of sample problems, techniques for presentation (e.g., keyword searchable transcripts, voice generators), etc.
- Builds on current engagements with customers in terms of support and agile development
- New interfaces and tools are provided as part of standard software maintenance

Innovation requires a cycle of feedback, learning, and adaptation to achieve adoption.

Questions?

Please wait for the microphone.
State your name and company.

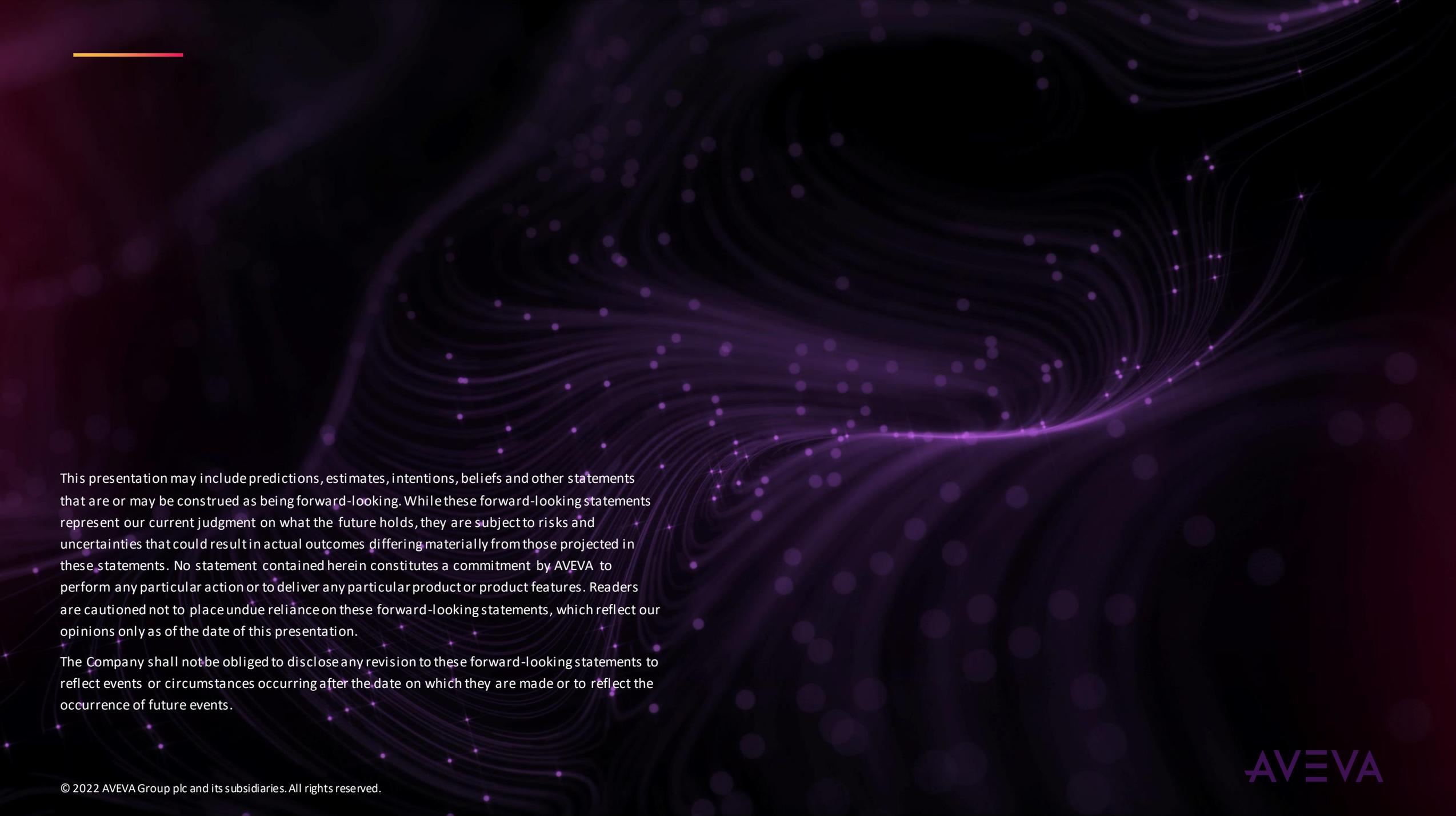


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Navigate to this session in the mobile app to complete the survey.



Thank you!



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The Company shall not be obliged to disclose any revision to these forward-looking statements to reflect events or circumstances occurring after the date on which they are made or to reflect the occurrence of future events.



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ABOUT AVEVA

AVEVA is a global leader in engineering and industrial software driving digital transformation across the entire asset and operational life cycle of capital-intensive industries.

The company's engineering, planning and operations, asset performance, and monitoring and control solutions deliver proven results to over 16,000 customers across the globe. Its customers are supported by the largest industrial software ecosystem, including 4,200 partners and 5,700 certified developers. AVEVA is headquartered in Cambridge, UK, with over 4,400 employees at 80 locations in over 40 countries.

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