Advanced analytics for petrochemicals production: case study

SEPTEMBER, 2018

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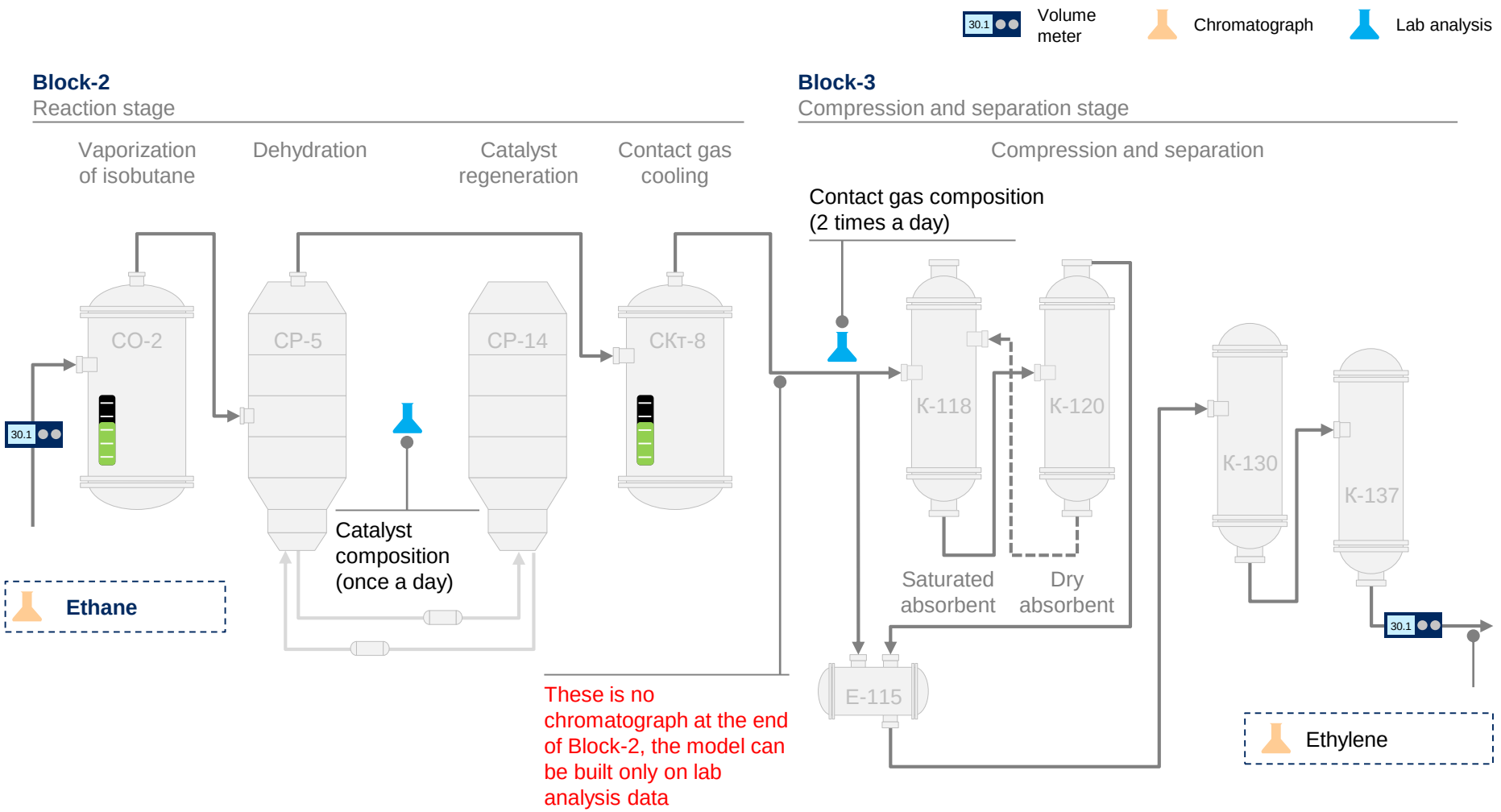
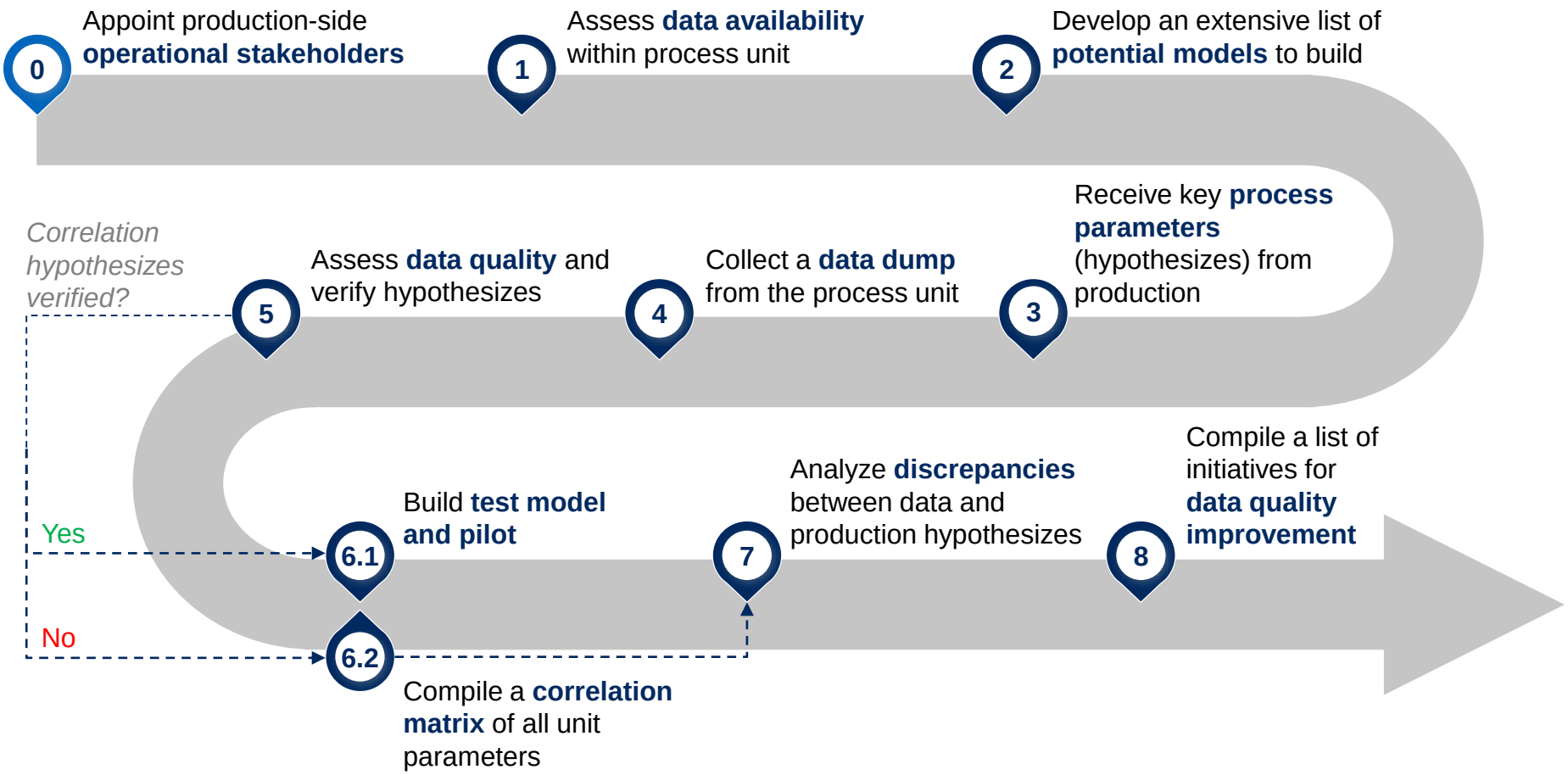
SOURCE: MAAG (Moscow Advanced Analytics Group)

Process diagram with key data sources for ethylene production unit

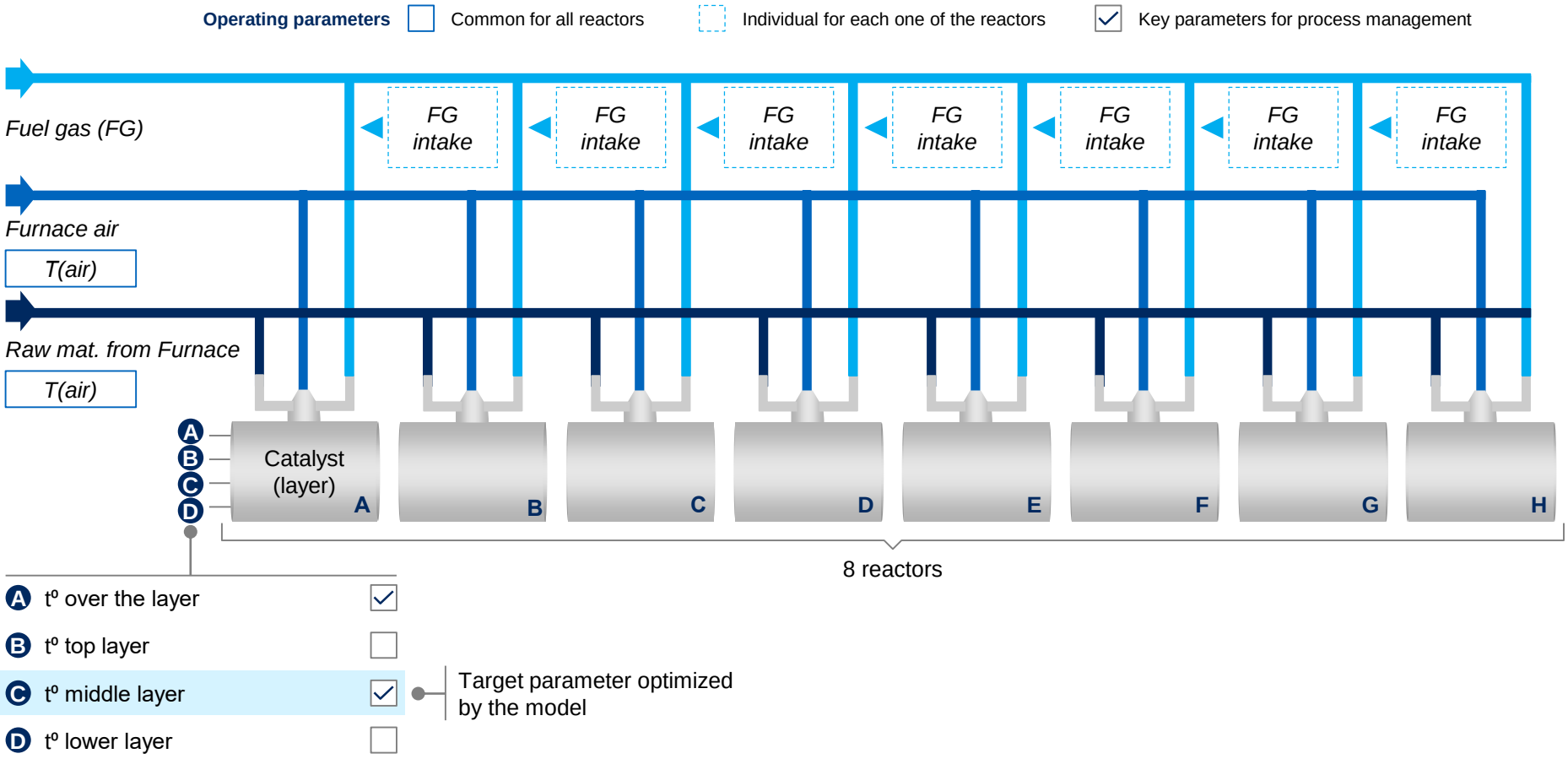


- Chromatographs are only used to assess dynamics of process parameters**, and not used to read an absolute value**
- The basis for estimation of target product volume and quality is a **lab analysis, conducted 1-2 times per day**

Production process unit AA diagnostics is structured in 8 key steps (1/3)



The model provides end-to-end optimization through all 8 reactors



- **Middle catalyst layer temperature is maintained using a number of control parameters:**
  - **Common for all reactors: furnace air temperature**
  - **Individual for all reactors: fuel gas valve clearance**
- **The model optimizes these parameters to minimize deviation from target temperature**
- **The model also includes**
  - **Air consumption and raw materials temperature**

Based on multiple linear regressions the model defines suggested optimal alterations in control parameters

ILLUSTRATIVE

Modelling approach

- We have identified key control and operating parameters, which influence the Ethylene output
- Your role is to identify coefficients for linear regressions on Ethylene output
- After that you need to build an optimization engine on top of the regression model and provide recommendations on **manipulable** variables

Modelling results

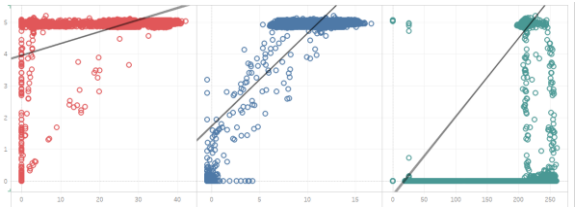
Parameters	Coefficients	Time lag, hours
Ethane intake	1,61	3
Temperatures in reactor	0,74-0,84	7
Hydrogen / Hydrocarbon	2,76	3

Goal function: To maximize Ethylene output

The task consists of three key things

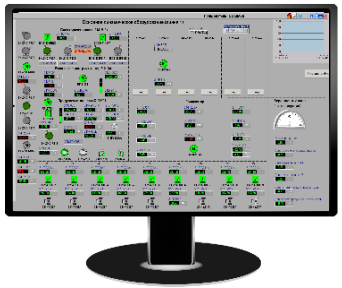
Regression

- Build a regression model **for ethylene output**
- Model precision will be measured using **validation set** on Sunday using **adjusted R-squared** metric



Optimization model

- Build an **optimization model** for ethylene output with **variable parameters** (column “Manipulated”) **under the constraints** (column “Constraint”)



Optimal scenario

- Obtain an **optimal scenario** based on **validation set** on Sunday