



Finding a needle in a haystack – how to control almost everything in a measurement system

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Cesar Roberto Rodrigues
Rosemberg Leite



Content

Brazilian Royalty Framework

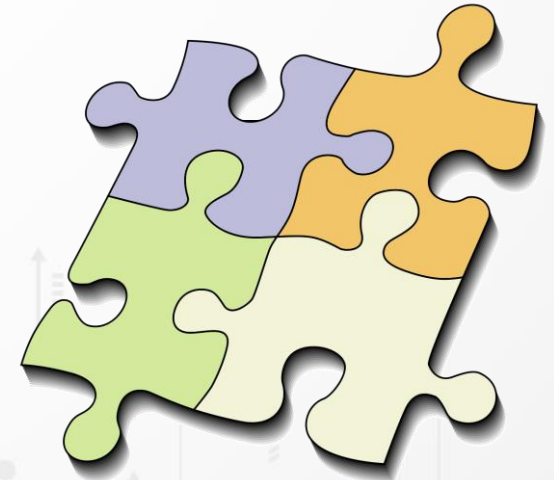
Brazilian Flow Metering Regulation

Measurement Management System

Conclusion

Brazilian Royalty Framework

- Too many stakeholders
 - Cities, states, federal government, special funds.
- Allocation per well
 - Depends on well production and physical location.
- Production information in *real-time*
 - Data straight from the flow computer on a daily basis.



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Brazilian Flow Metering Regulation

Several resolutions:

Joint Resolution ANP/INMETRO n°1/2013	Technical Regulation for Petroleum and Natural Gas Measurement
Resolution ANP n°52/2013	Technical Regulation for Implementation of Chemical Analysis Results
Resolution ANP n°18/2014	Technical Regulation for Metering System Failures
Resolution ANP n°65/2014	Technical Regulation for Production Data
Resolution ANP n°44/2015	Technical Regulation for Usage of Multiphase Meters
Official Letter ANP/NFP 0007/2015 Official Letter ANP/NFP 0009/2015 Official Letter e-ANP/NFP 0001/2020	Other clarifications on measurement systems

Brazilian Flow Metering Regulation

Deadlines are everywhere:

Requeriment	Deadline	Source
Flow meter calibration	3, 6 or 12 months	Joint Resolution ANP/INMETRO nº1/2013
Calibration certificate emission	10 business days	Official Letter e-ANP/NFP 0001/2020
Calibration results implementation	3 business days	Official Letter e-ANP/NFP 0001/2020
Gas sampling	30 days	Joint Resolution ANP/INMETRO nº1/2013
Chromatography results emission	25 days	Resolution ANP nº52/2013
Well testing	42 or 90 days	Joint Resolution ANP/INMETRO nº1/2013
Sending production data	3 business days	Resolution ANP nº65/2014
Metering system failure communication	72 hours	Resolution ANP nº18/2014

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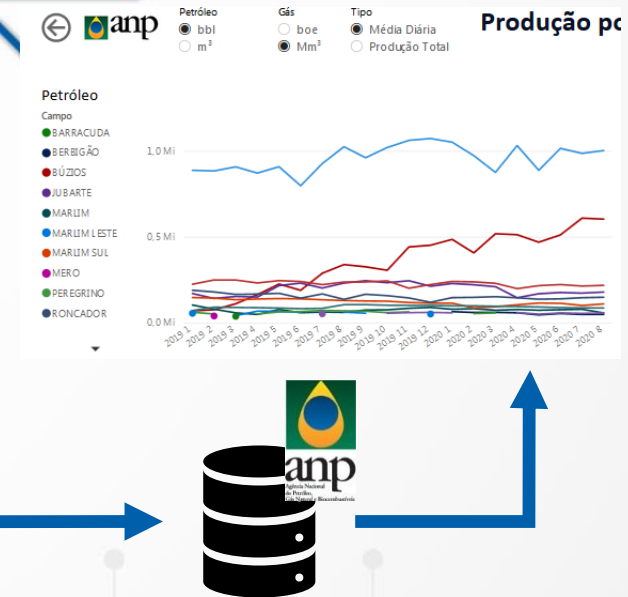
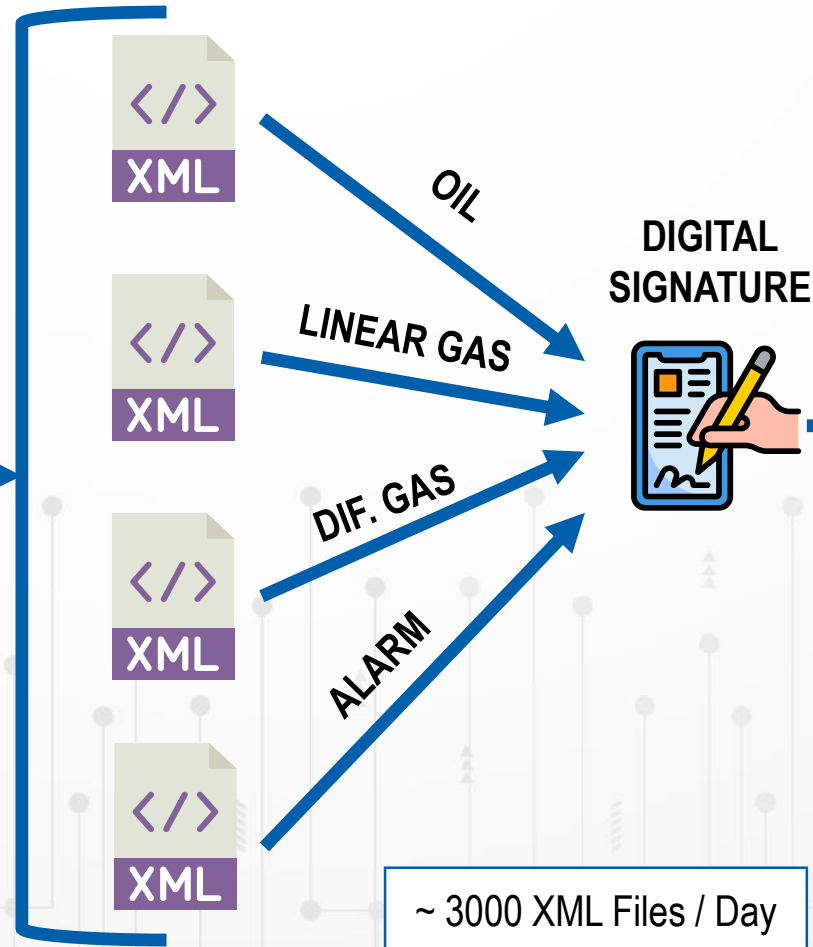
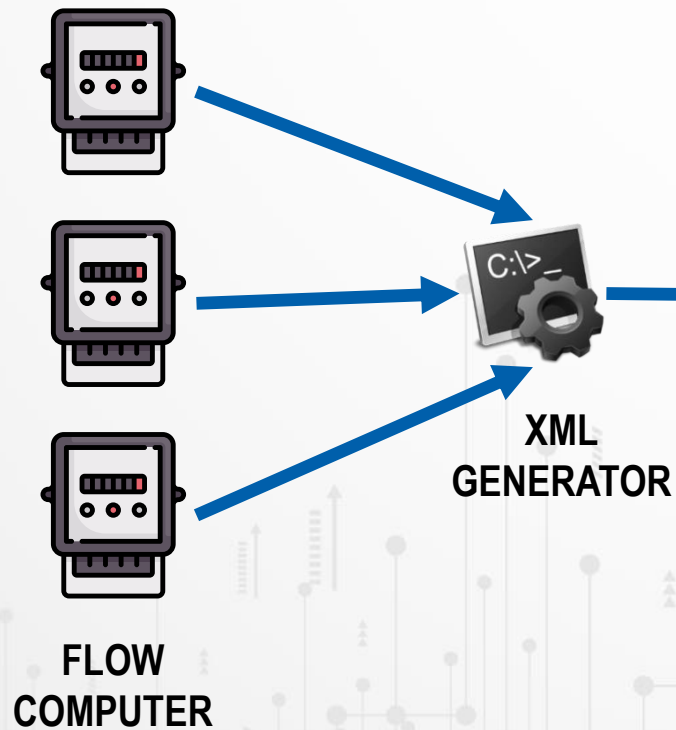
Brazilian Royalty Framework

Brazilian Flow Metering Regulation

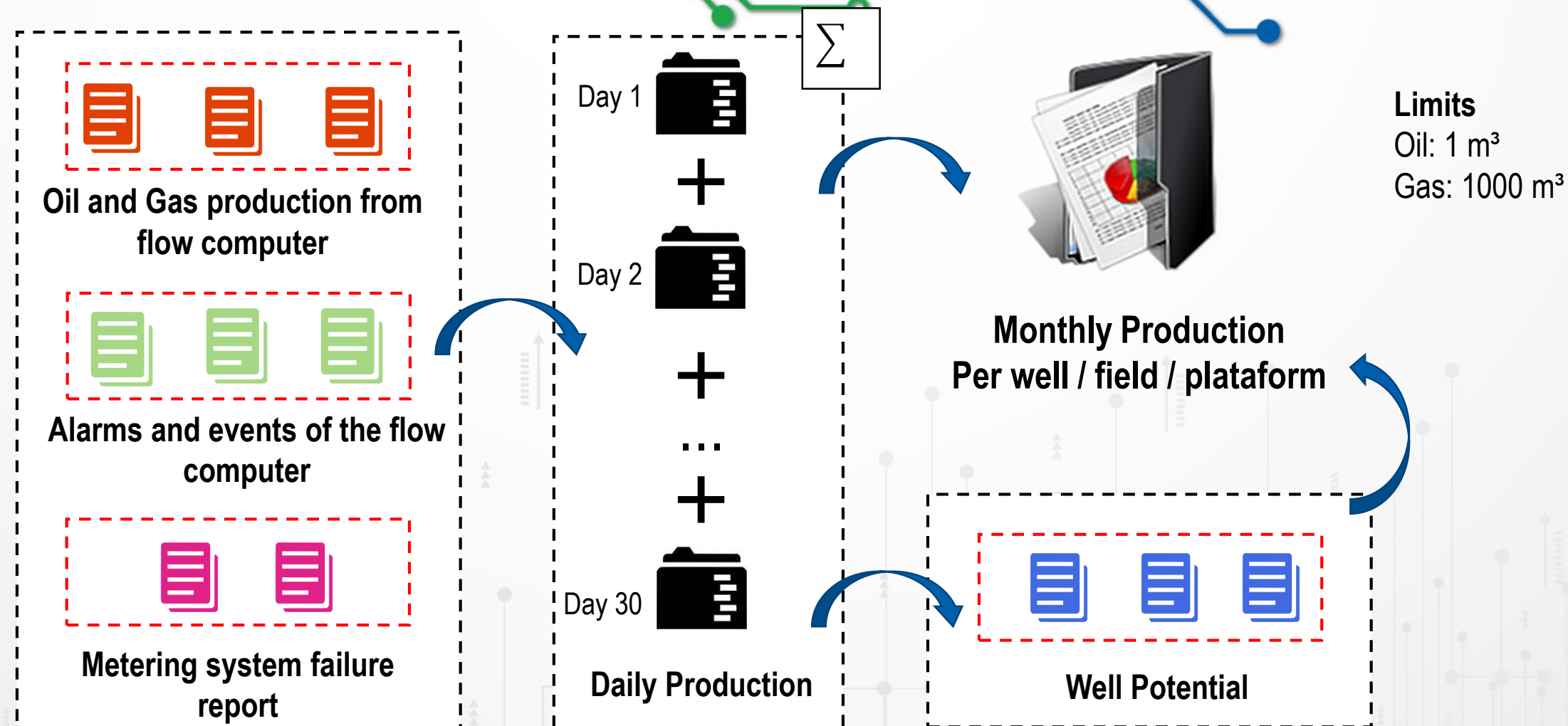
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Getting Data Straight From The Field



How the allocation process works



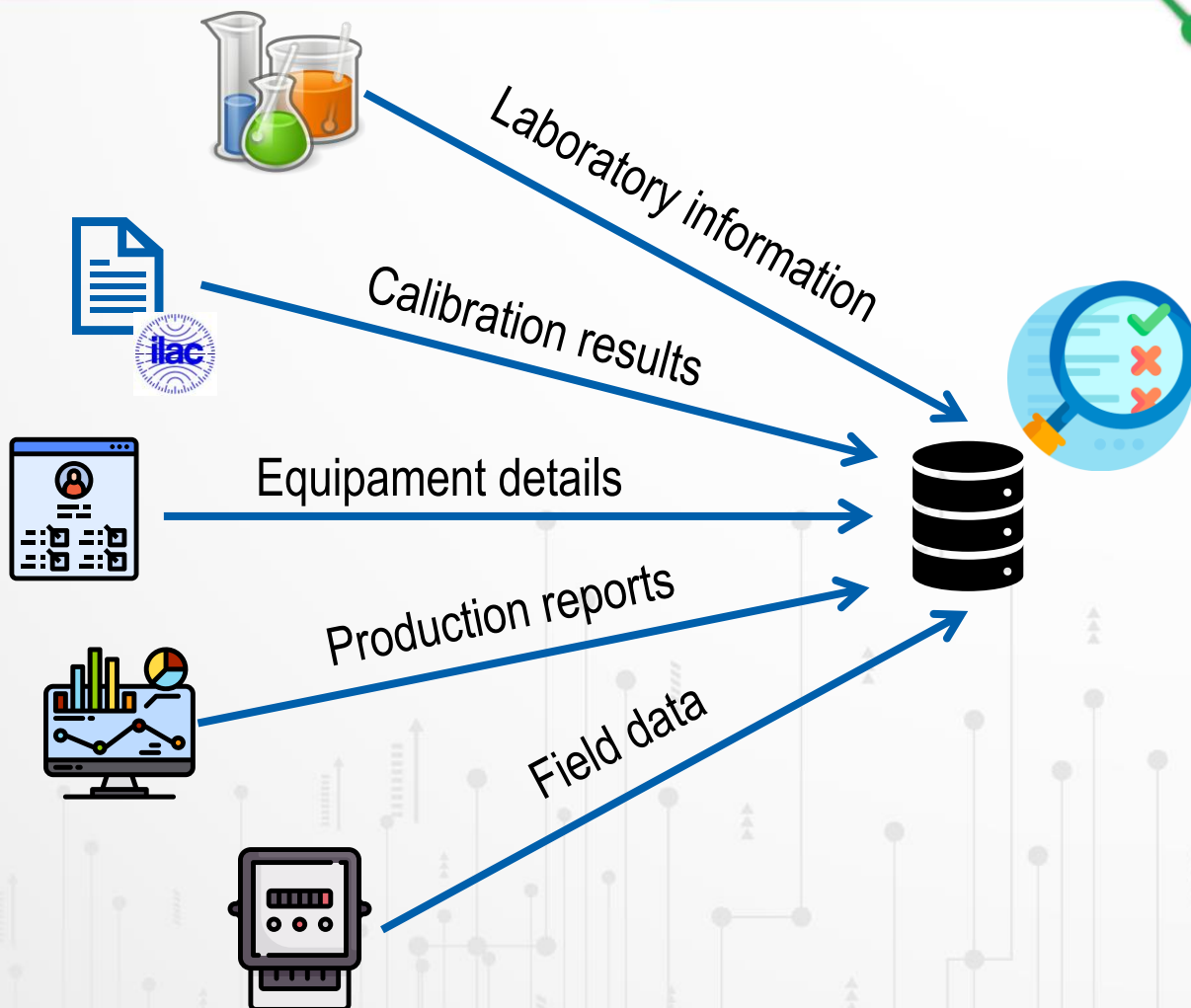
Production data – Much more than flow

- Flow conditions
 - Temperature, pressure, correction factors
- Fluid properties
 - Gas chromatography, BSW, shrinkage factor
- Metering configuration
 - Meter factor, k-factor, calibration points, alarms
- Metering system details
 - Serial number, firmware, installation

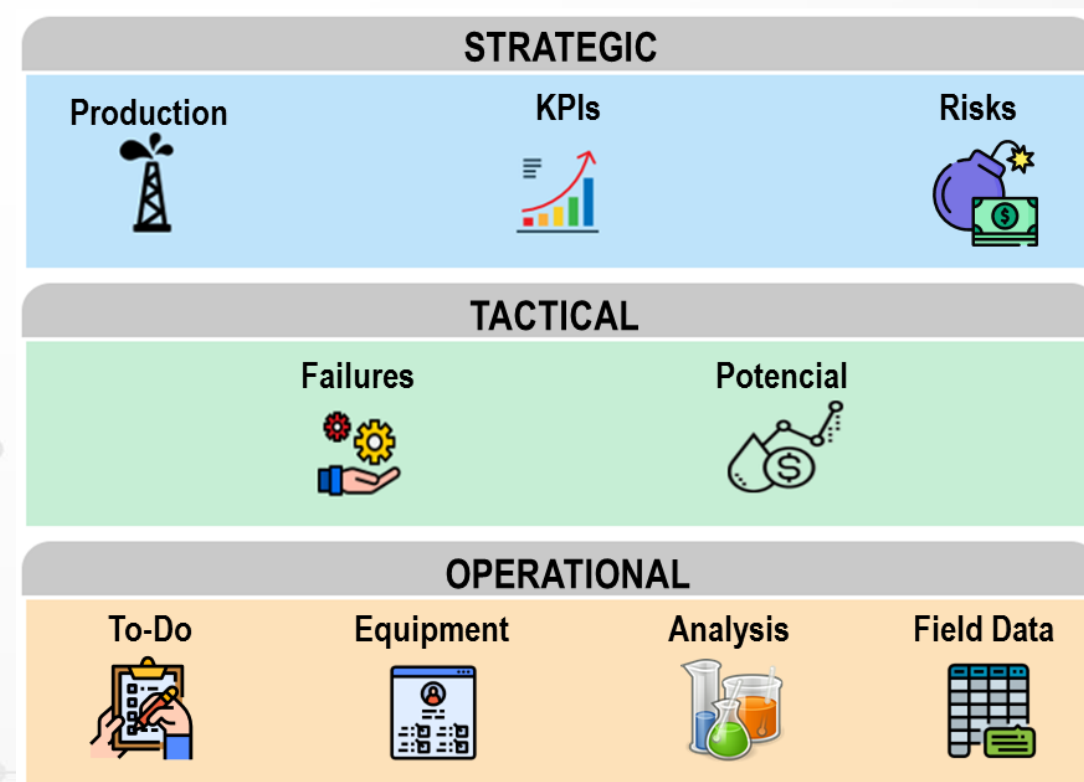
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An integrated measurement management system



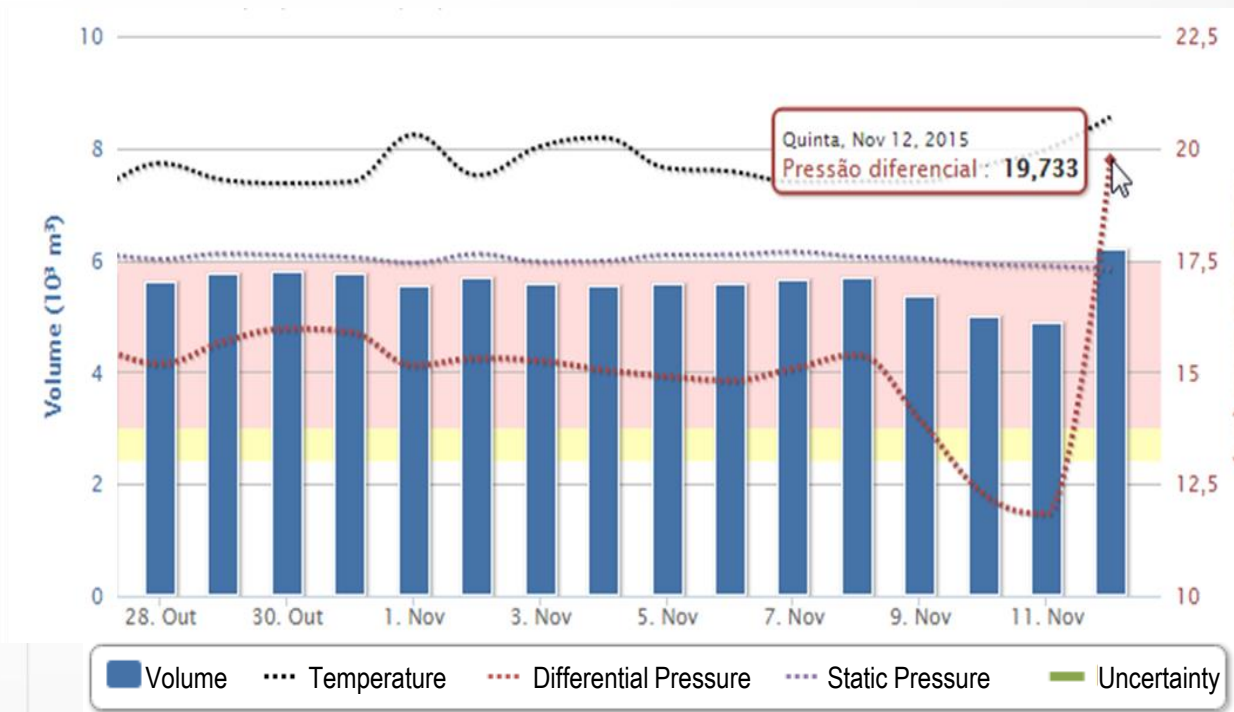
Metering Panel



An integrated measurement management system

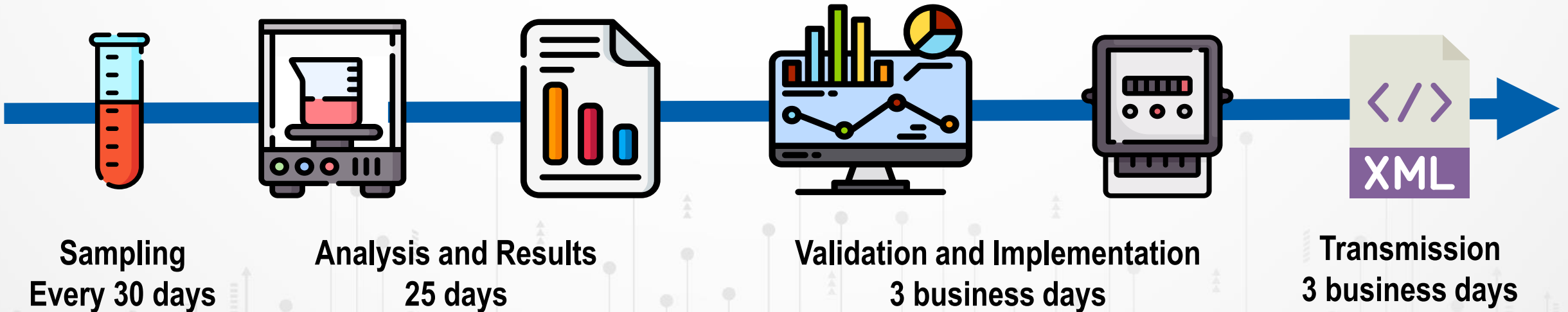
On screen and emails alerts

- Data from the flow computer is being sent?
- Chromatography is according to the latest result?
- Calibration results were implemented in time?
- Any event or alarm that should be a concern?



Control of the entire measurement process

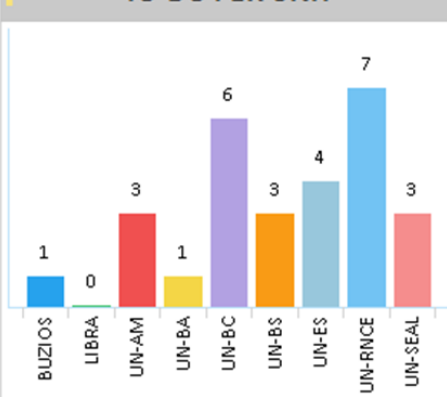
Chemical Analysis Process



Control of the entire measurement process



TO-DO PER UNIT



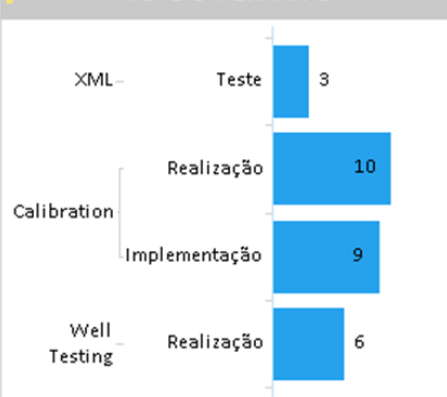
XML

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UN-BC	P-18	7-MRL-215HP...	Teste	20/09/2020
UN-BC	P-18	7-MRL-173HP...	Teste	19/09/2020
UN-BA	OP-CN	7-CNC-24-ES	Teste	19/09/2020

CHEMICAL ANALYSIS

UN	RESPO...	IDENTIFICAD...	PENDÊNCIA	DATA REFERÊ...
UN-BA	OP-CN	3-FAJ-4D-ES	Transporte	04/07/2020

TO-DO PER TYPE



WELL TESTING

UN	RESPO...	IDENTIFICAD...	PENDÊNCIA	DATA REFERÊ...
UN-BS	FPCI	7-BAN-1-SPS	Realização	04/07/2020
UN-BS	FPCSQ	7-LL-80DB-RJS	Realização	04/07/2020

CALIBRATION

UN	RESPO...	IDENTIFICAD...	PENDÊNCIA	DATA REFERÊ... V.
BUZIOS	P-77	FIT-1212001A	Realização	04/07/2020

Control of the entire measurement process

Validation of Gas Chromatography Results

Gráfico	Análise T-Student	Amostras participantes				
Componente	Interv. de confiança	Resultado teste	Média	Variância	Desv. padrão	Grau de liberdade
C1 METANO	79,61 ... 85,76	87,29	82,68	8,57	2,93	5
C2 ETANO	5,6 ... 8,26	4,83	6,93	1,6	1,27	5
C3 PROPANO	3,49 ... 5,59	2,87	4,54	1,01	1,01	5
IC4 ISOBUTANO	0,71 ... 0,93	0,65	0,82	0,02	0,11	5
NC4 N-BUTANO	1,13 ... 1,59	1,04	1,36	0,05	0,22	5
IC5 ISOPENTANO	0,24 ... 0,35	0,24	0,29	0,01	0,06	5
NC5 N-PENTANO	0,27 ... 0,42	0,29	0,34	0,01	0,07	5
C6 HC EM C6	0,19 ... 0,45	0,27	0,32	0,02	0,13	5
C7 HC EM C7	0,15 ... 0,65	0,32	0,4	0,06	0,24	5
C8 HC EM C8	0,2 ... 0,51	0,33	0,36	0,03	0,15	5
C9 HC EM C9	0,13 ... 0,3	0,31	0,22	0,01	0,08	5
C10 HC EM C10	0,03 ... 0,16	0,19	0,1	0,01	0,06	5

Results vs Flow Computer

-	11/06/2019	5727957	14/06/2019
Componente	Amostra	XML	
metano	73.81	73.26	!
etano	10.8	10.71	!
propano	8.88	9.08	!
nButano	2.5	2.69	!
iButano	1.26	1.34	!
nPentano	0.52	0.6	!
iPentano	0.43	0.44	✓
hexano	0.19	0.23	!

Configuration changes alerts

De: SMED - Suporte do Sistema <SMED@petrobras.com.br>
Enviada em: quarta-feira, 9 de setembro de 2020 12:02
Para: Augusto Proenca da Silva <augusto.proenca@petrobras.com.br>
Assunto: [AVISO] - Alteração de dados de equipamentos - 08/09/2020

Prezado(a) AUGUSTO PROENCA DA SILVA,

Segue a lista de pontos de medição que tiveram equipamentos alterados em **08/09/2020**.

Instalation	TAG	Description	XML field	Old value	New Value
Plataform X	EMED-02	Meter serial number	NUM_SERIE_ELEMENTO_PRIMARIO	SAP-1651247	SAP-2133793
Plataform X	EMED-03	Meter factor 1	ICE_METER_FACTOR_1	0,99920	0,99940
Plataform Y	FIT1234	Flow computer firmware	DSC_VERSAO_SOFTWARE	24.75.01 (EB23)	24.75.02
Plataform Z	FQI-9999	Orifice plate diameter	MED_DIAMETRO_REFERENCIA	0037,600	0062,110
Plataform Z	FQI-9999	% C2	PCT_CROMATOGRAFIA_ETANO	7,860000	9,290000
Plataform Z	FQI-9999	% C3	PCT_CROMATOGRAFIA_PROPANO	5,980000	6,380000
Plataform Z	FQI-9999	% C6	PCT_CROMATOGRAFIA_HEXANO	0,450000	0,200000

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- Every day, lots of information about the metering system that goes beyond flow are generated and stored.
- Being able to use that information in an integrated way can reduce the exposure to non-conformities and helps to improve system efficiency.
- Too much information, if you don't know how to use it, is as bad as no information at all.



Contact Us

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