



AVEVA WORLD

Albemarle Intelligence

**Top 10 Reasons Why You are Stuck in Pilot Purgatory:
*Preventing ROAI & Realizing Economies of Scale***

Presented by: Jonathan Alexander



Current Estimated Improvements

>\$150,000,000/yr

Amsterdam, Netherlands

Magnolia, AR, USA

Xinyu, China

Barbours, TX, USA

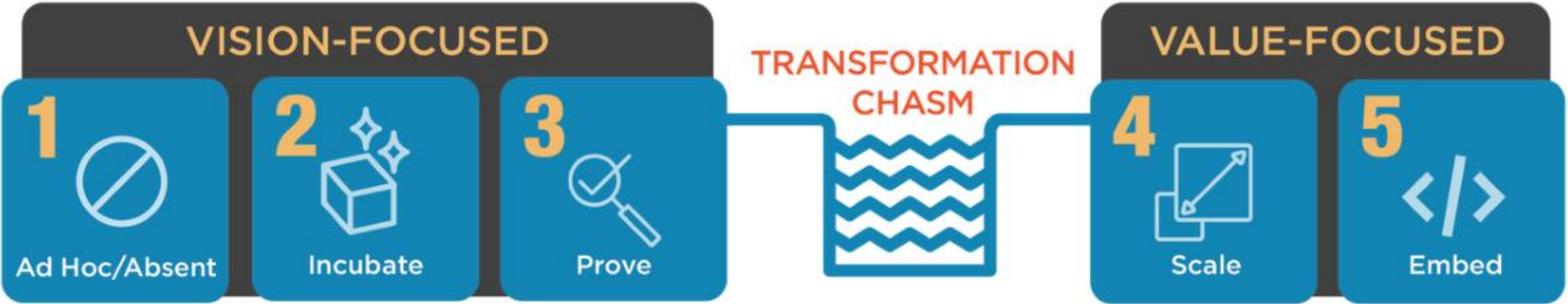
Kings Mountain, NC, USA

LaNegra, Chile

Kemerton, Australia

Estimated improvements include projects at multiple sites with various time periods and benefits including cost savings, cost avoidance and/or revenue enhancement.

Five Stages of Transformation Maturity



Source:  **LNS**
Research



Top 10 Reasons you're stuck in Pilot Purgatory

Reason #1

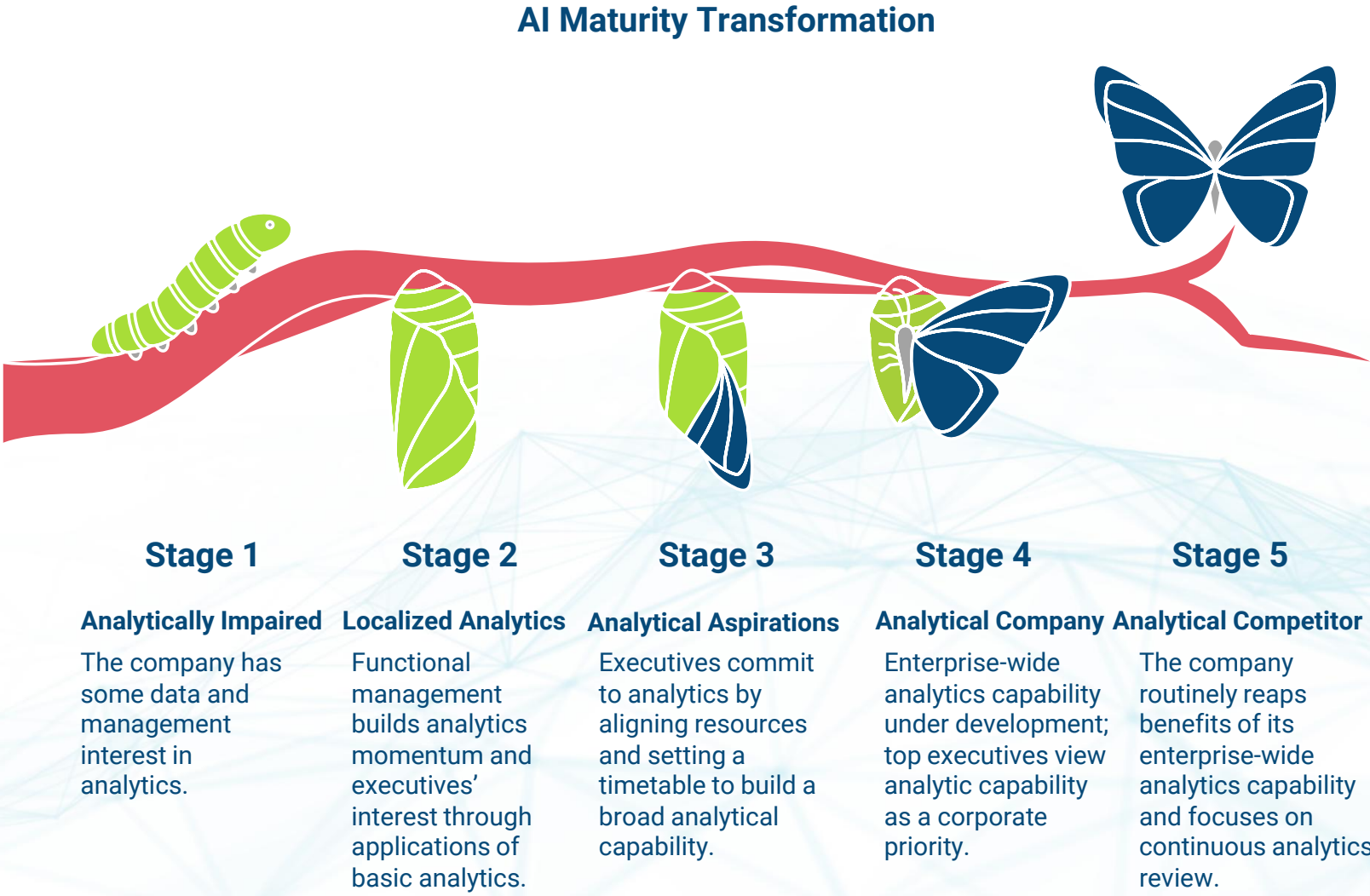


**Rome wasn't
built in a day**

The Journey to Realizing Economies of Scale



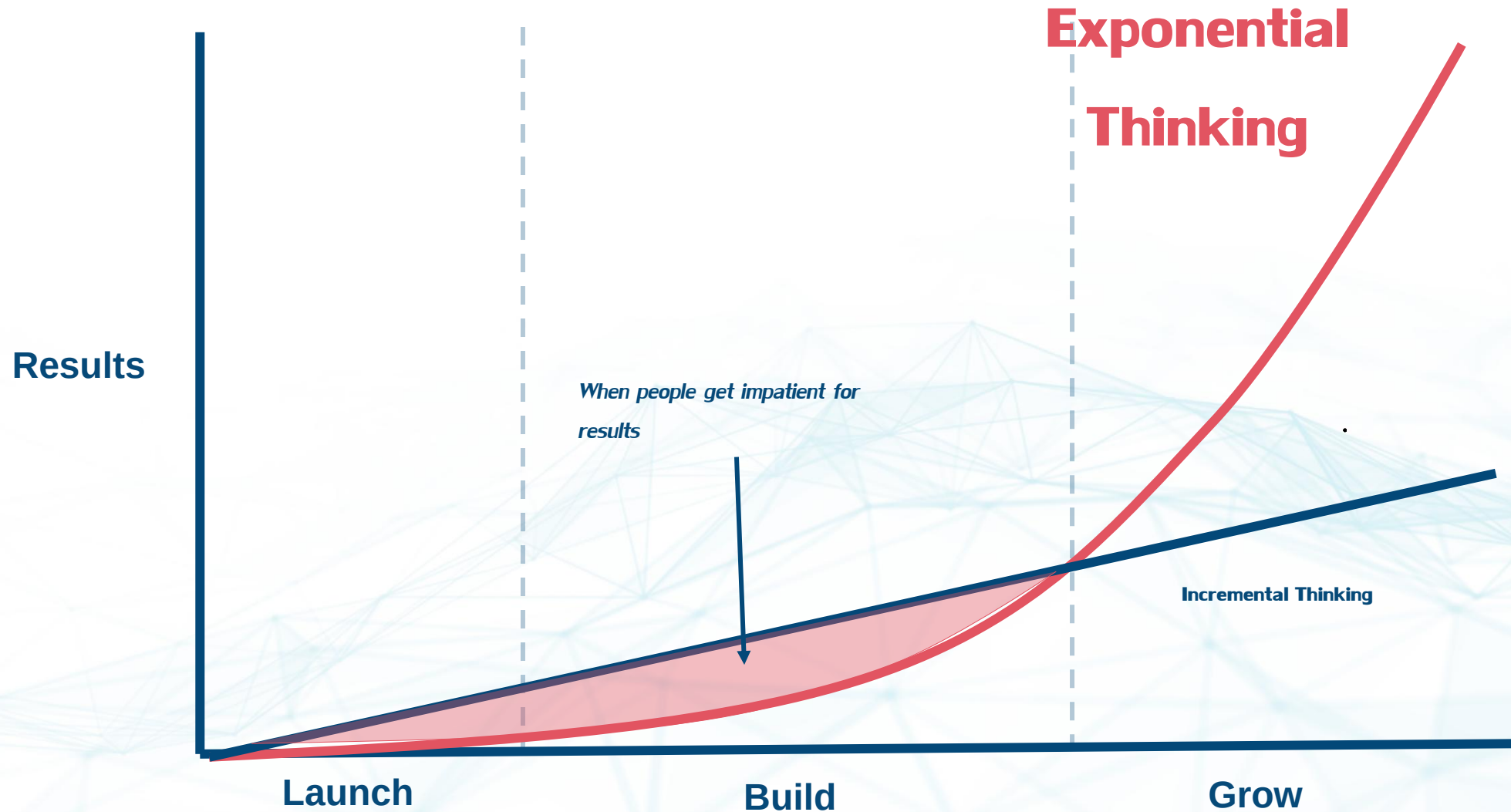
Competing on Analytics - Five Stages of Analytical Maturity



AI Maturity Index

	 Beginner	 Foundational	 Advanced	 World Class
Data Governance	Minimal data governance; siloed and unstructured data.	Basic data management policies in place; some centralized storage.	Enterprise-wide data governance framework; standardized data practices.	Fully integrated, automated data governance with real-time compliance.
Statistical Process Control	No formal SPC; reactive quality control.	Basic SPC tools implemented; manual monitoring.	Automated SPC with real-time alerts and analytics.	AI-driven SPC with predictive quality insights and autonomous adjustments.
Machine Learning	Limited awareness; isolated experiments.	Early adoption; ML models used for specific tasks.	Scalable ML models integrated into workflows.	AI-powered decision-making with continuous learning and optimization.
Predictive Analytics	Basic dashboards with historical data analysis.	Simple trend analysis and forecasting.	Predictive models guiding business decisions.	AI-driven prescriptive analytics optimizing operations in real-time.
Generative AI	No generative AI implementation.	Experimentation with text/image generation in isolated use cases.	Generative AI integrated into product design and optimization.	Fully autonomous generative AI creating insights, reports, and designs with minimal human input.

Phases of Digital Transformation – Incremental vs. Exponential

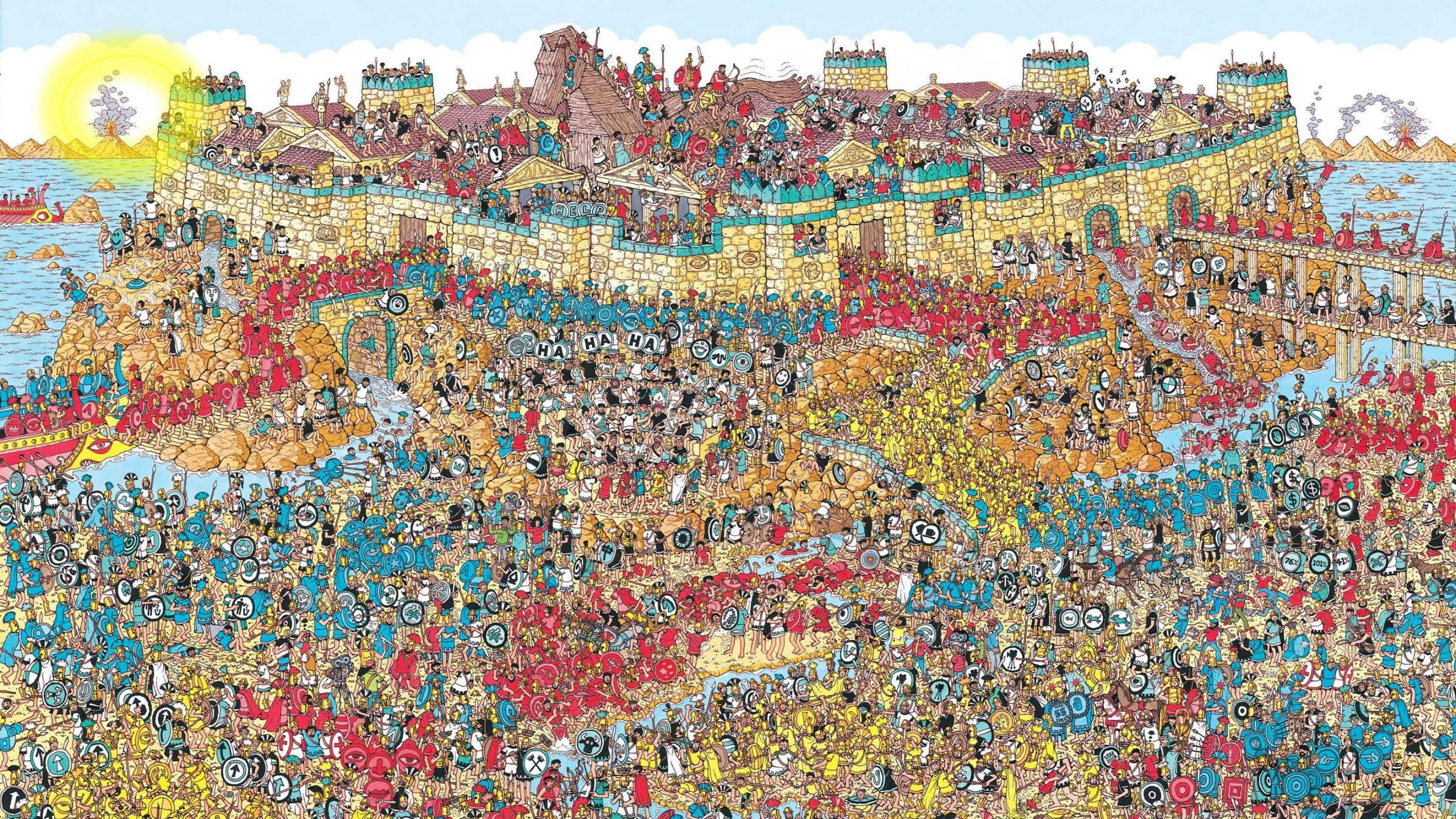


Reason #2

Garbage In, Garbage Out









What can I help with?

Ask anything

I

+

🌐

Search

🔍

Deep research

...

🔊

🖼️

Create image

✍️

Help me write

📄

Summarize text

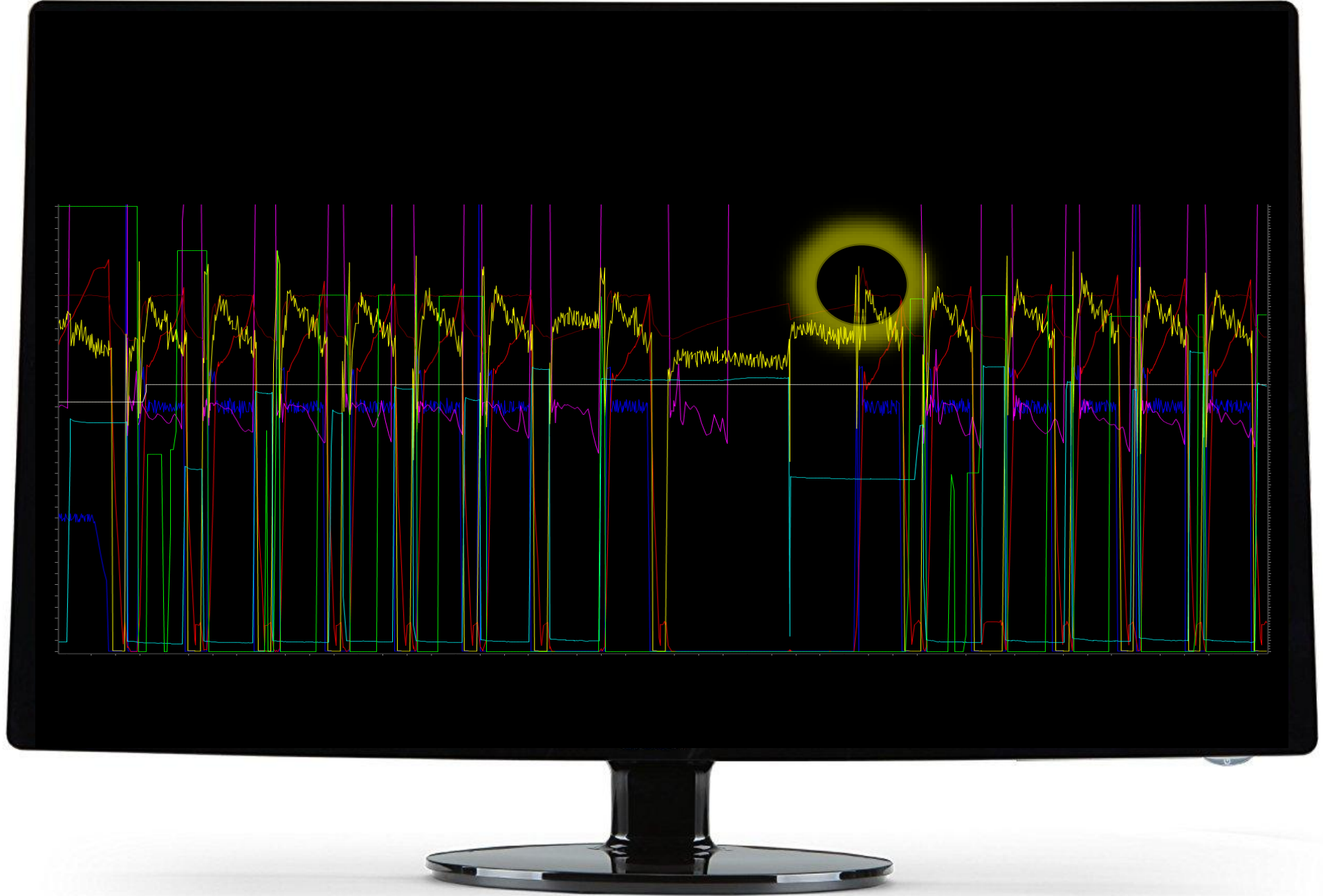
💻

Code

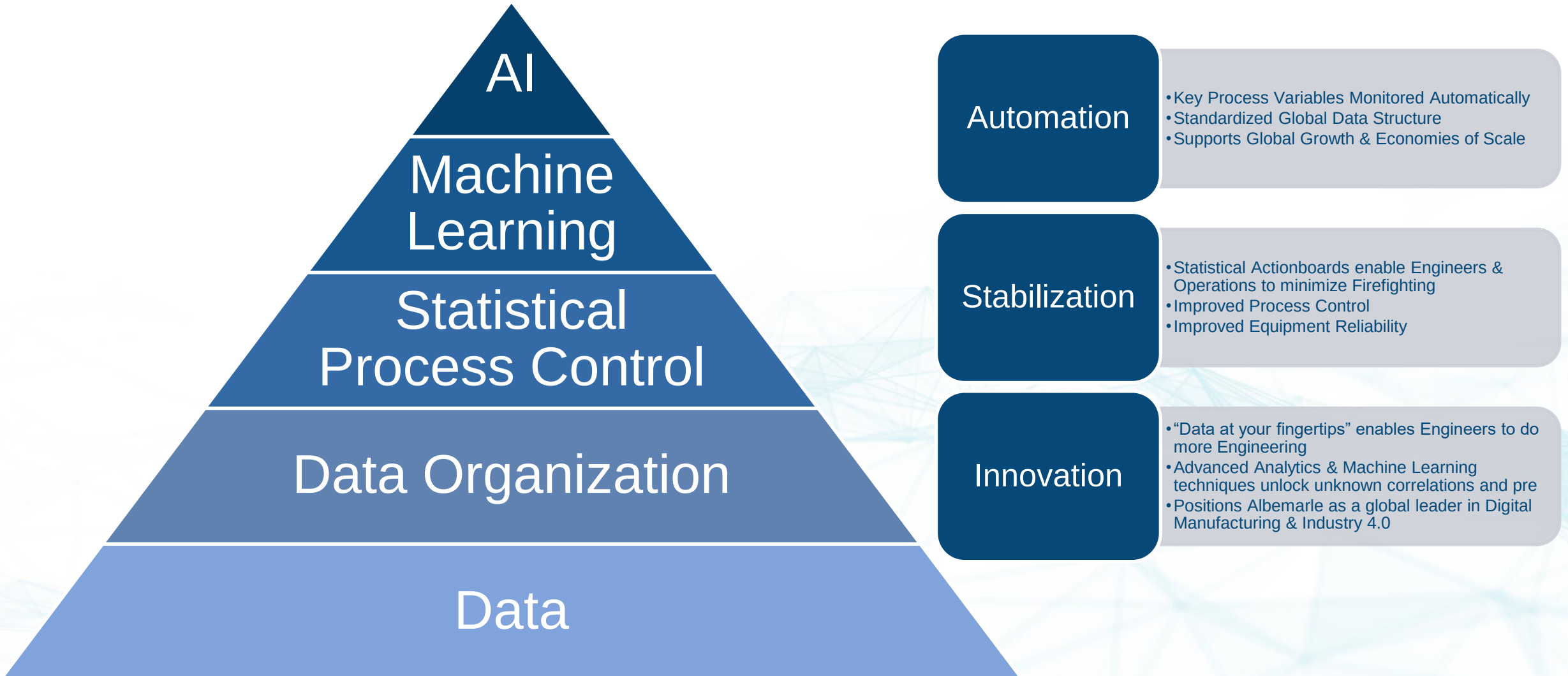
💡

Brainstorm

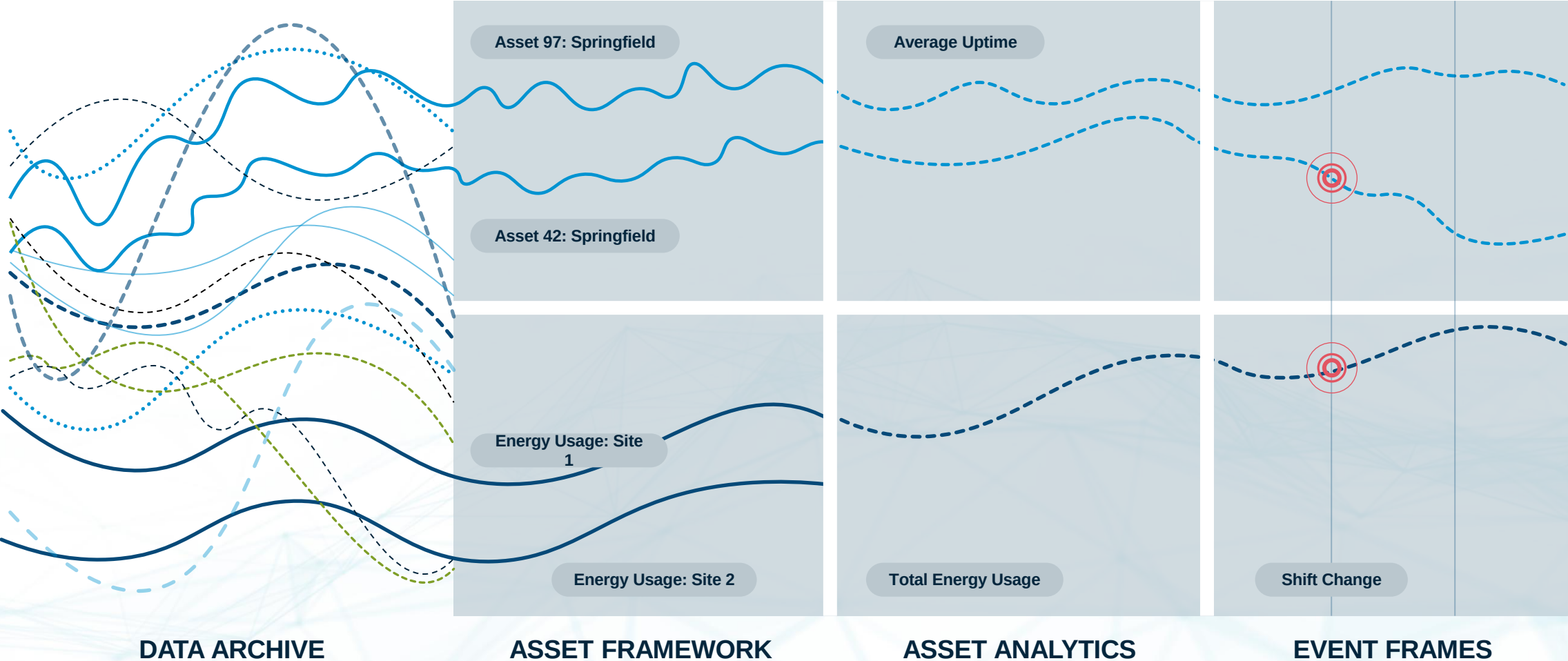
More



AI Strategy



Scaling Event Frames as an Analytical Engine

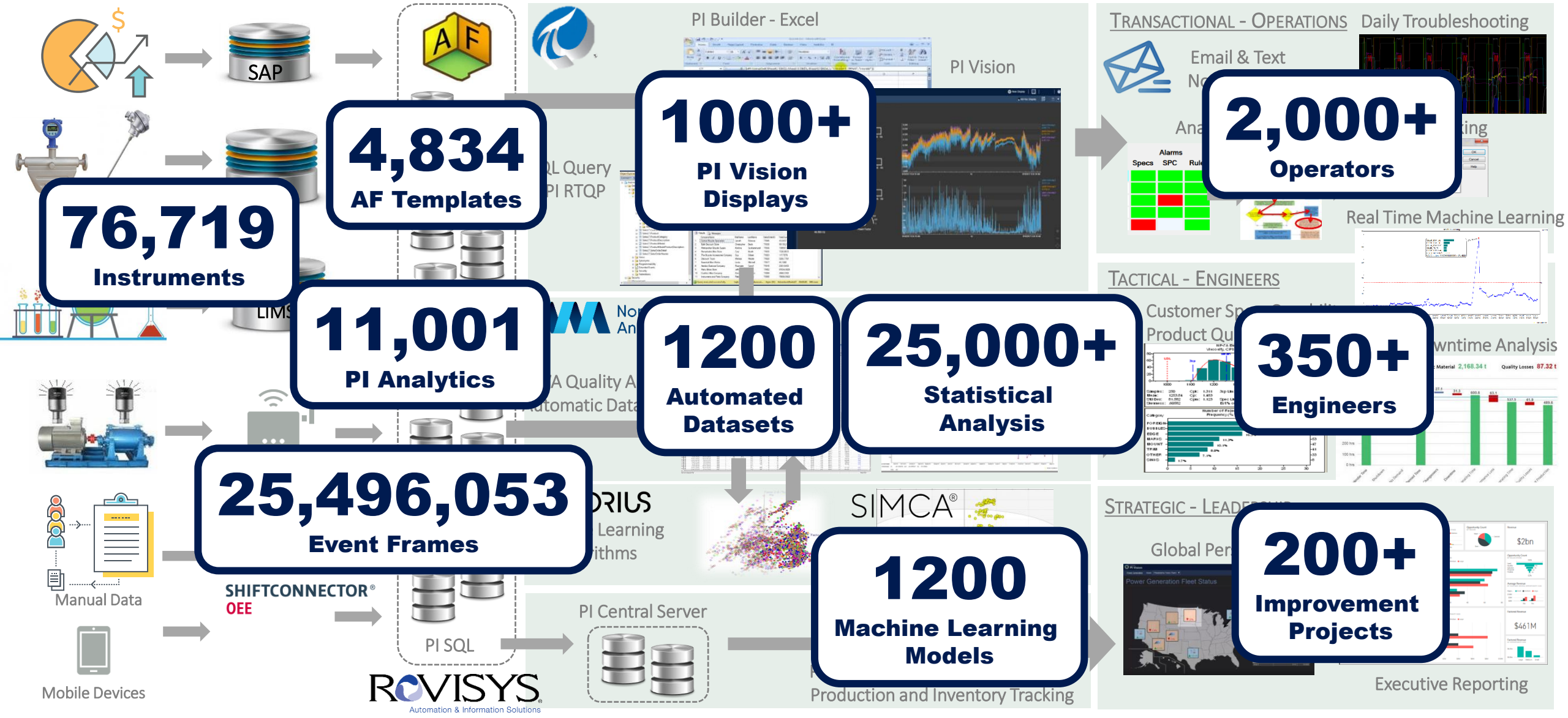


DATA SOURCES

AVEVA PI SYSTEM ASSET FRAMEWORK

DATA ANALYTICS SUITE

USER ROLES



Reason #3

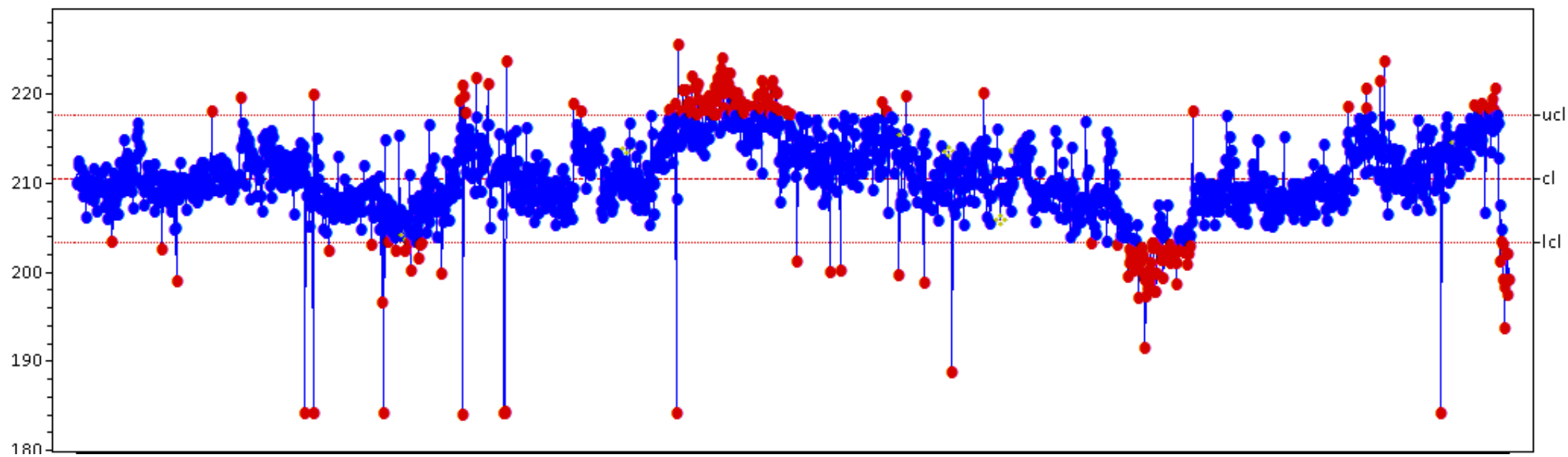
An aerial photograph of a vast, dense forest of evergreen trees. The sun is low on the horizon, creating a warm, golden glow that filters through the trees and illuminates the misty valleys between the mountains in the background. The sky is filled with soft, golden light and some wispy clouds. The text "You miss the forest from the trees" is overlaid in a large, bold, dark blue font with a white outline, centered across the middle of the image.

**You miss the
forest from
the trees**

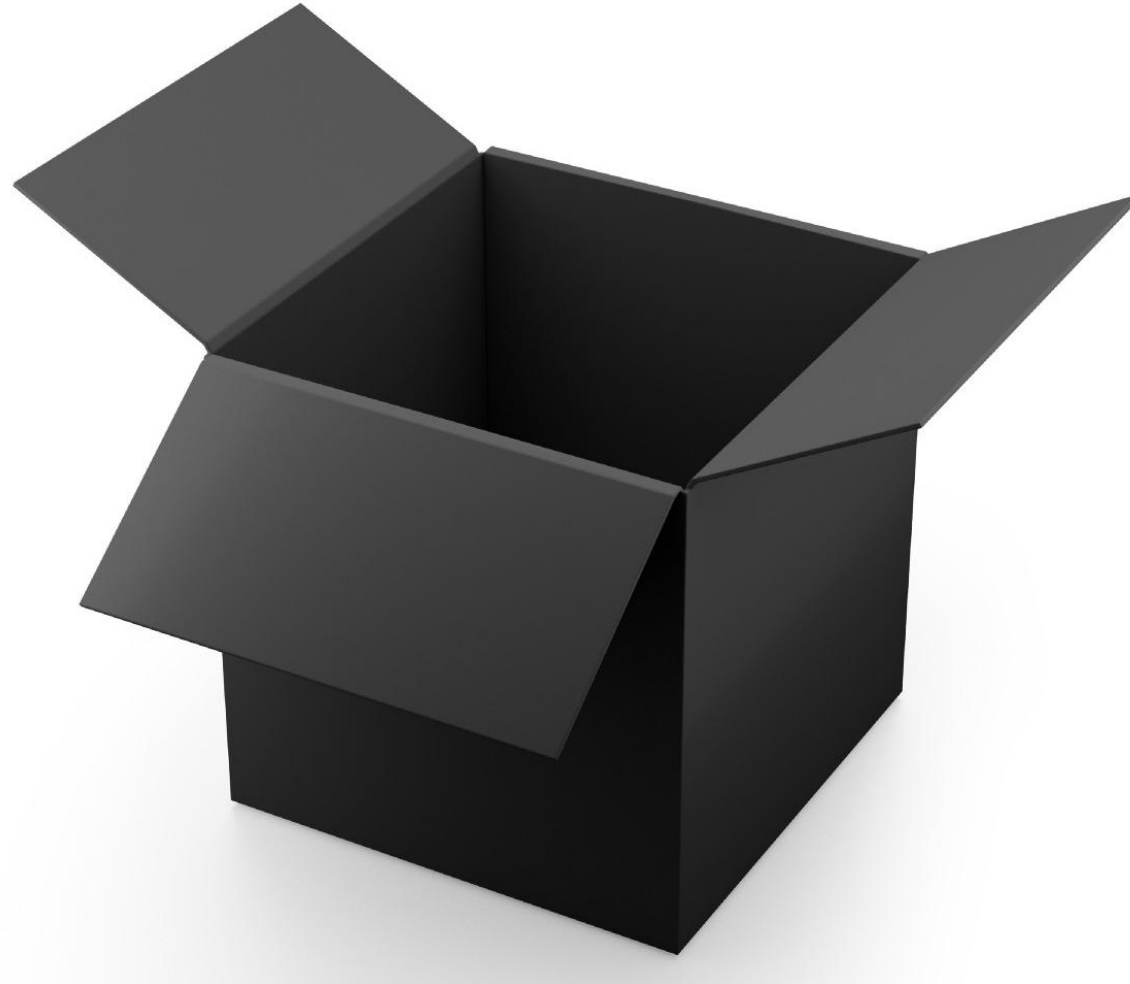


A-Shift vs C-Shift

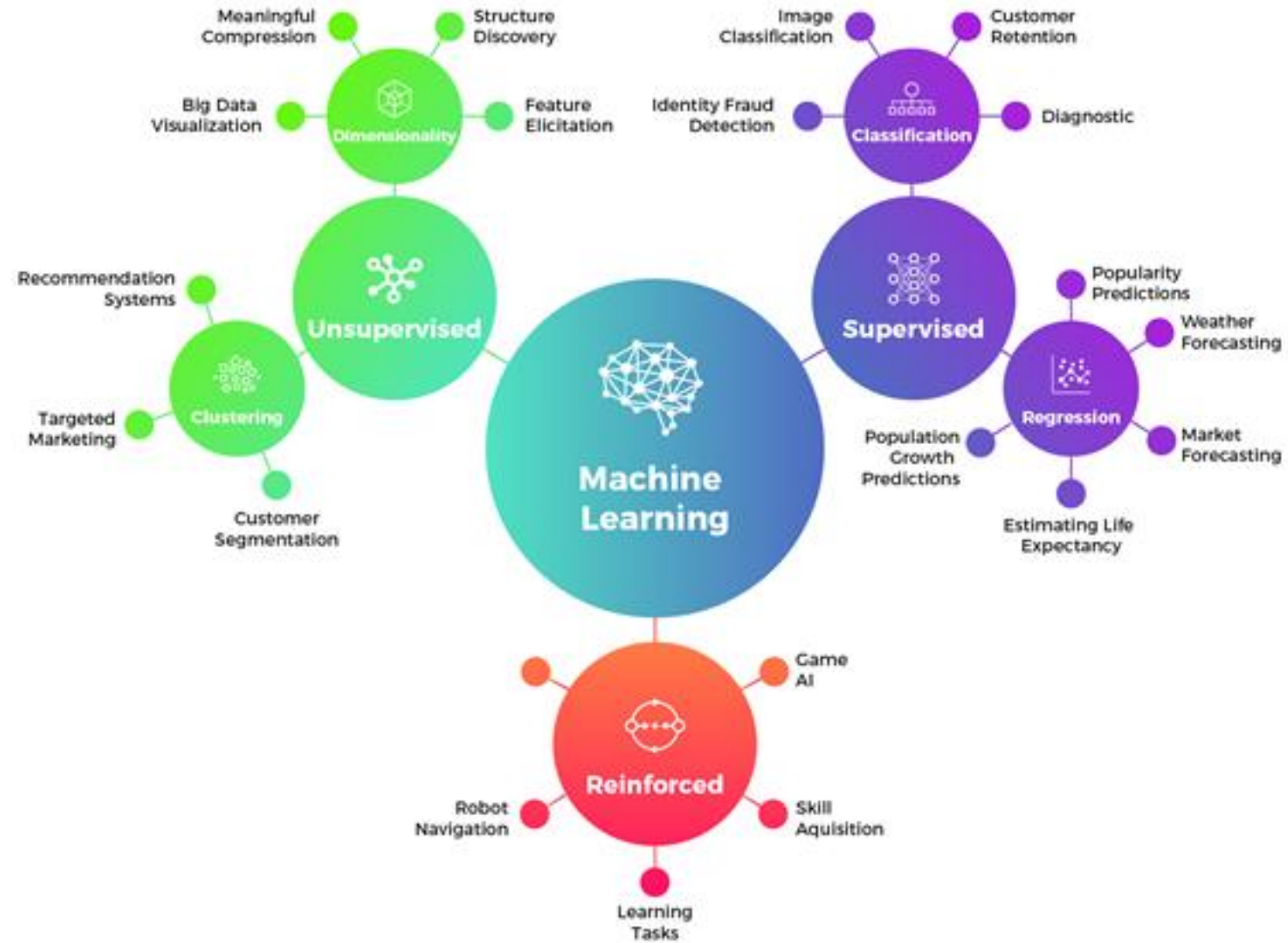
3 Month Statistical Analysis – w/ Event Frames



Dissecting the “Black Box” with Machine Learning



DIFFERENT TYPES OF MACHINE LEARNING



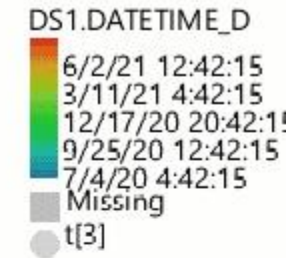
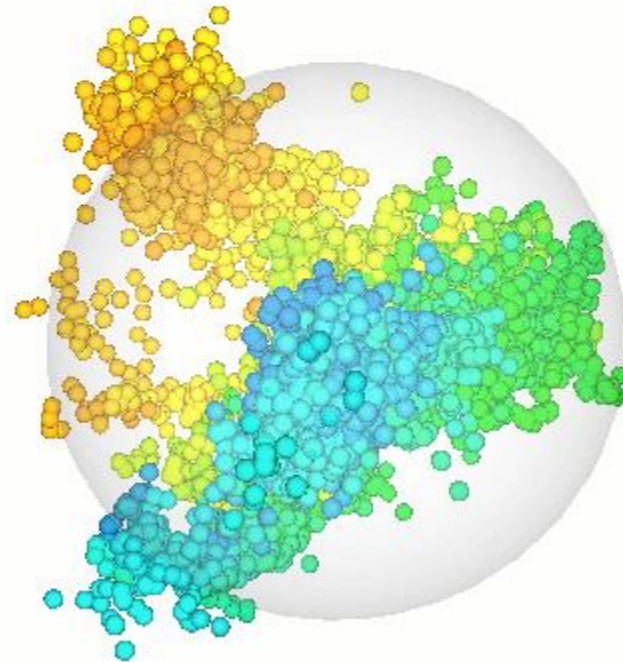
Principle Component Analysis



DATA EXPLORATION



**FINDING HIDDEN
PATTERNS / STRUCTURE**

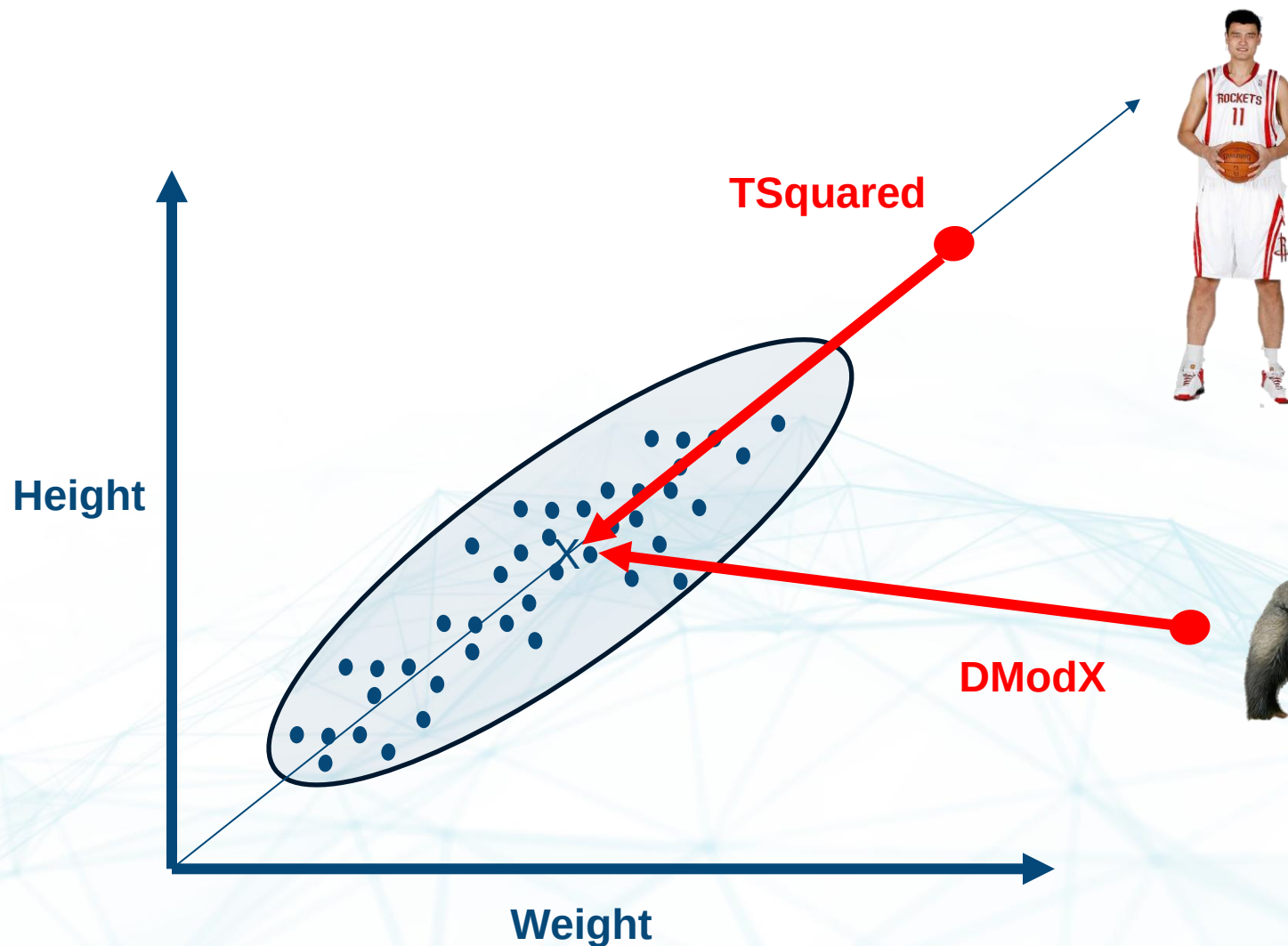


**ANOMALY & OUTLIER
DETECTION**



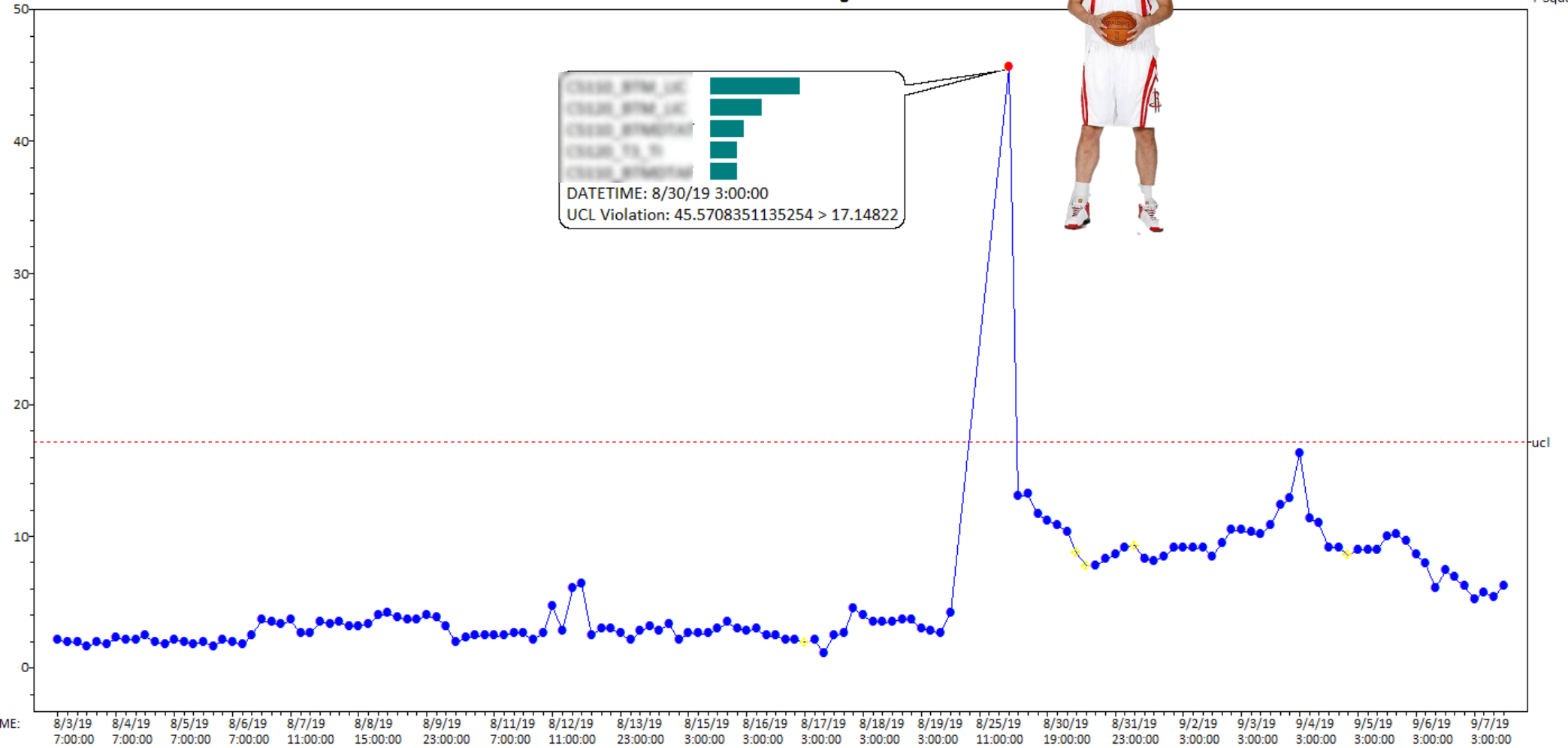
**CHANGE IN OPERATING
CONDITIONS**

Machine Learning – Outlier & Anomaly Detection



Machine Learning

T-Squared



DATETIME: 8/3/19 7:00:00 8/4/19 7:00:00 8/5/19 7:00:00 8/6/19 7:00:00 8/7/19 11:00:00 8/8/19 15:00:00 8/9/19 23:00:00 8/11/19 7:00:00 8/12/19 11:00:00 8/13/19 23:00:00 8/15/19 3:00:00 8/16/19 3:00:00 8/17/19 3:00:00 8/18/19 3:00:00 8/19/19 3:00:00 8/25/19 11:00:00 8/30/19 19:00:00 8/31/19 23:00:00 9/2/19 3:00:00 9/3/19 3:00:00 9/4/19 3:00:00 9/5/19 3:00:00 9/6/19 3:00:00 9/7/19 3:00:00

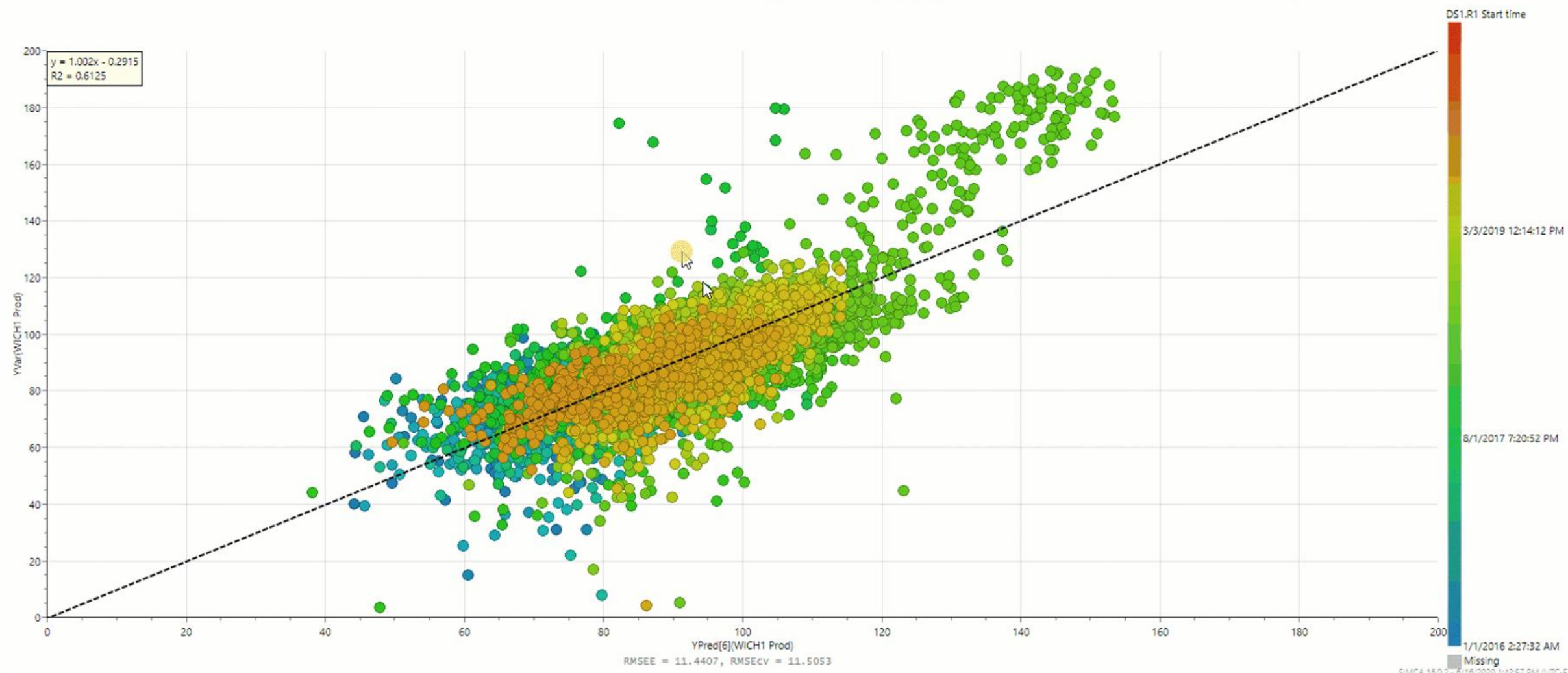
T-squared: cl: None ucl: 17.14822 lcl: None

◆ Rule Violation

Project Window - M20 (PLS) - Up to Dec '19

Number	Model	Type	A	N	R2X(cum)	R2Y(cum)	Q2(cum)	Date	Title	Hierarchical
17	M17	PLS	5	641	0.294	0.302	0.254	4/30/2020		
18	M18	PLS	10	641	0.526	0.299	0.241	4/30/2020		
19	M19	PLS	10	639	0.537	0.306	0.251	4/30/2020		
20	M20	PLS	6	7230	0.337	0.389	0.385	6/16/2020	Up to Dec '19	

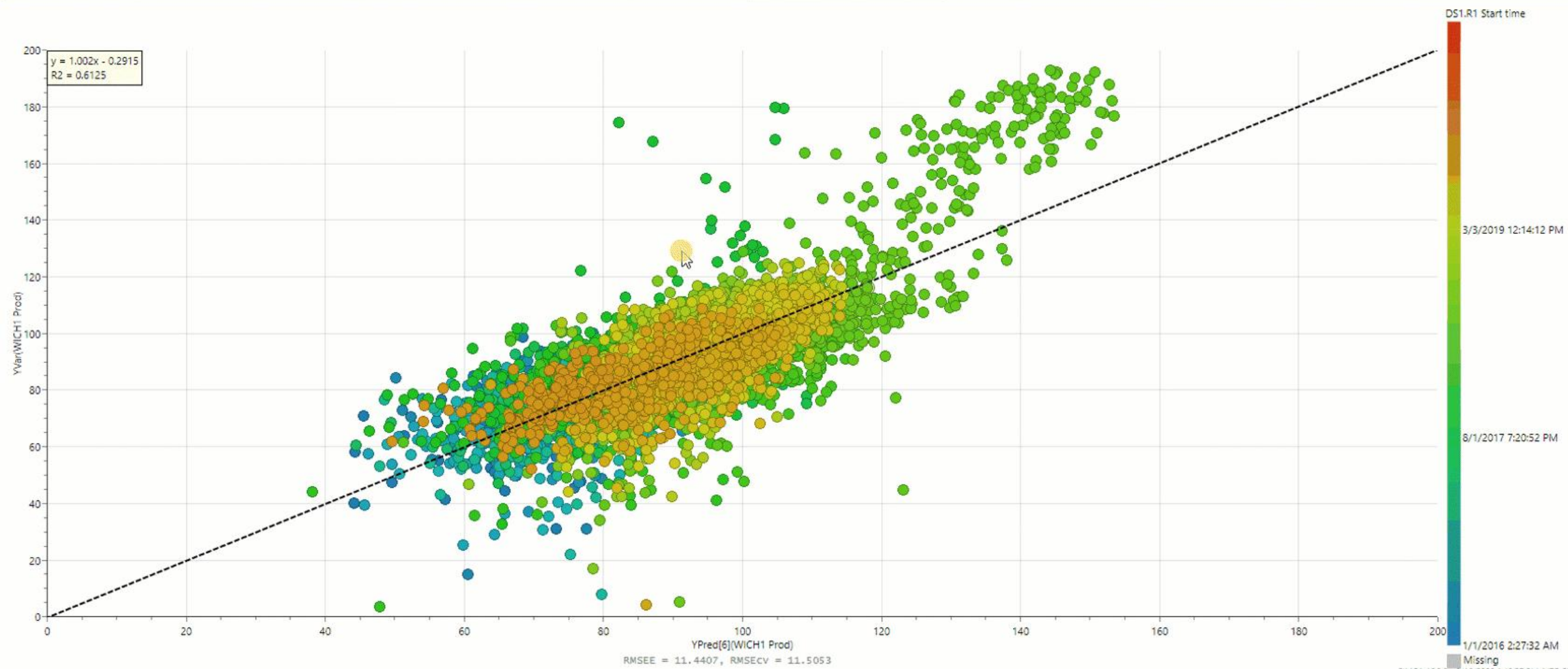
Observed vs. Predicted [M19] Loading Scatter Plot [M19] Score Scatter Plot [M19] Contribution Plot [M20] Observed vs. Predicted [M20] X Contribution Plot [M20] XVar Plot [M20] Contribution Plot [M20] XVar Plot [M20]



Project Window - M20 (PLS) - Up to Dec '19

Number	Model	Type	A	N	R2X(cum)	R2Y(cum)	Q2(cum)	Date	Title	Hierarchical
17	M17	PLS	5	641	0.294	0.302	0.254	4/30/2020		
18	M18	PLS	10	641	0.526	0.299	0.241	4/30/2020		
19	M19	PLS	10	639	0.537	0.306	0.251	4/30/2020		
20	M20	PLS	6	7230	0.337	0.389	0.385	6/16/2020	Up to Dec '19	

Observed vs. Predicted [M19]	Loading Scatter Plot [M19]	Score Scatter Plot [M19]	Contribution Plot [M20]	Observed vs. Predicted [M20] X	Contribution Plot [M20]	XVar Plot [M20]	Contribution Plot [M20]	XVar Plot [M20]
------------------------------	----------------------------	--------------------------	-------------------------	--------------------------------	-------------------------	-----------------	-------------------------	-----------------



File

Home

Data

Analyze

Predict

View

Tools

Marked items

List

Scatter

Line

Column

Plot XObs

Plot YObs

Exclude

Include

Class

Labels

Hide

Show all

Unlock column Layout

Format symbol

Format label

Create from marked items

Drill down

Modify model

Project Window - M20 (PLS) - Up to Dec '19

Number	Model	Type	A	N	R2X(cum)	R2Y(cum)	Q2(cum)	Date	Title	Hierarchical
17	M17	PLS	5	641	0.294	0.302	0.254	4/30/2020		
18	M18	PLS	10	641	0.526	0.299	0.241	4/30/2020		
19	M19	PLS	10	639	0.537	0.306	0.251	4/30/2020		
20	M20	PLS	6	7230	0.337	0.389	0.385	6/16/2020	Up to Dec '19	

Scatter Plot [M19]

Score Scatter Plot [M19]

Contribution Plot [M20]

Observed vs. Predicted [M20]

Contribution Plot [M20]

XVar Plot [M20]

Contribution Plot [M20]

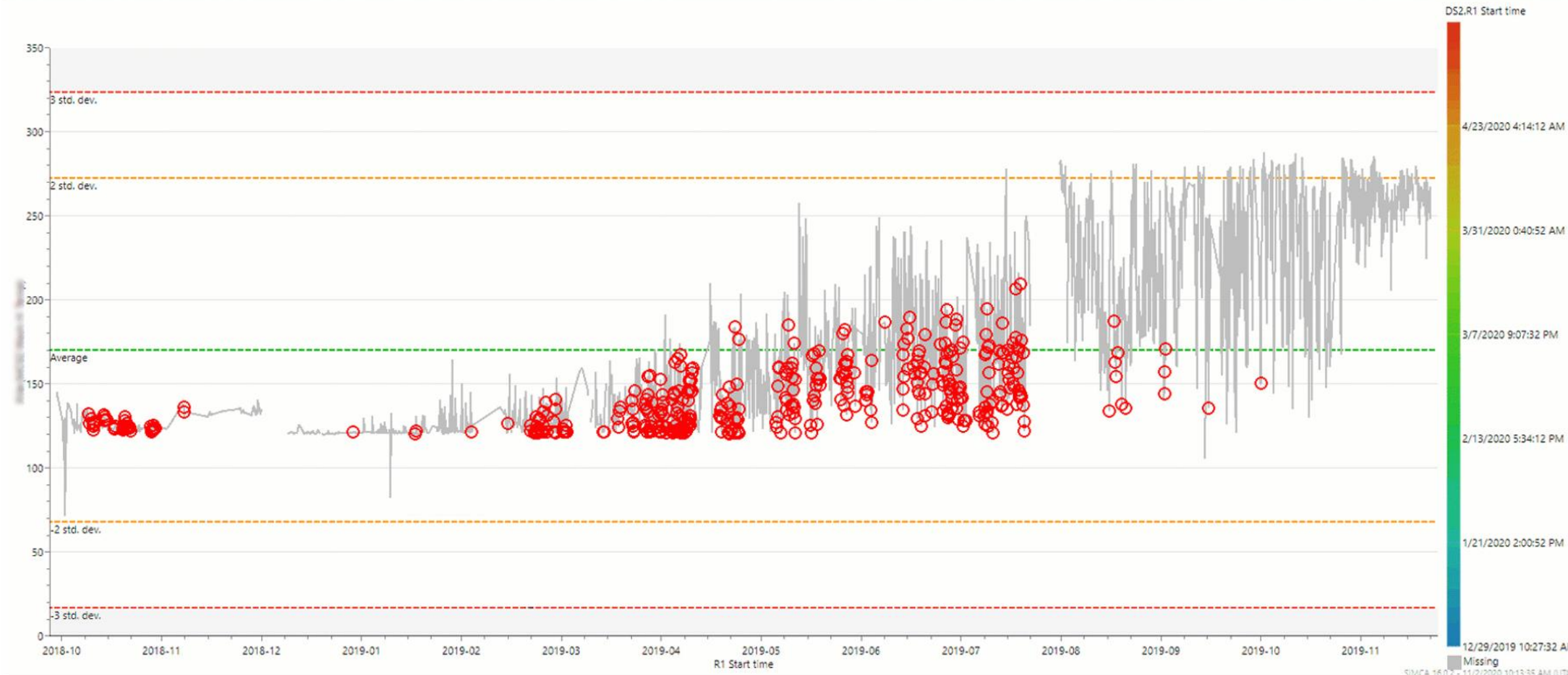
XVar Plot [M20]

Contribution Plot [M20]

XVar Plot [M20]

Contribution Plot [M20]

XVar Plot [M20]



Reason #4



**Your Insights
never convert
to Action**

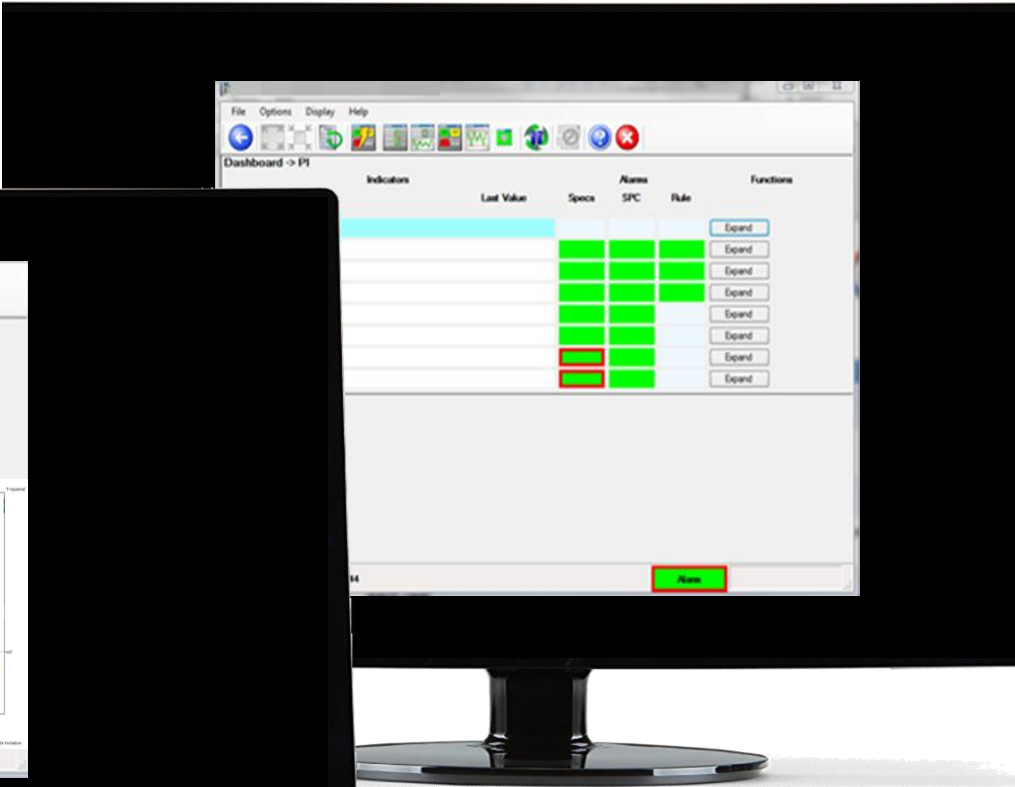
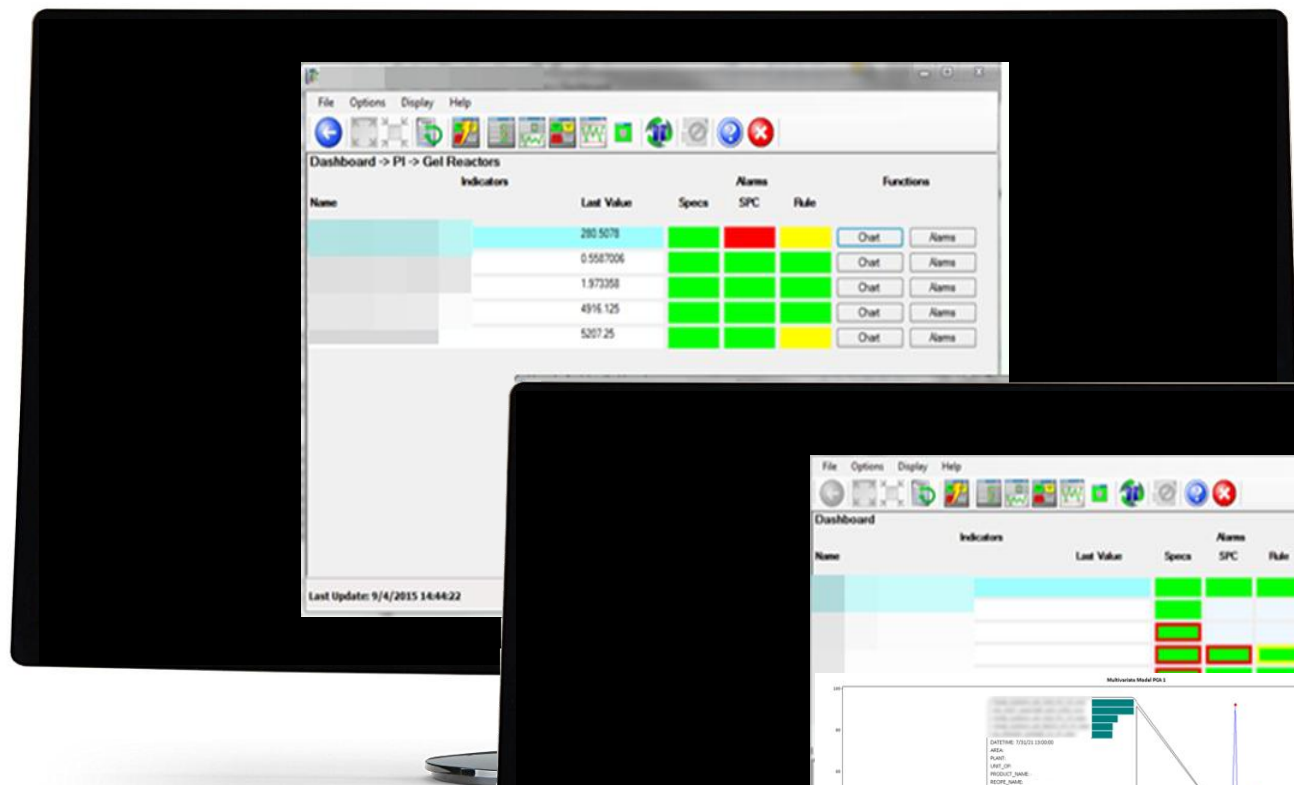
Data

Insights



**I GOT A FEVER, AND THE ONLY
PRESCRIPTION IS**

MORE DASHBOARD!



SARTORIUS SIMCA®

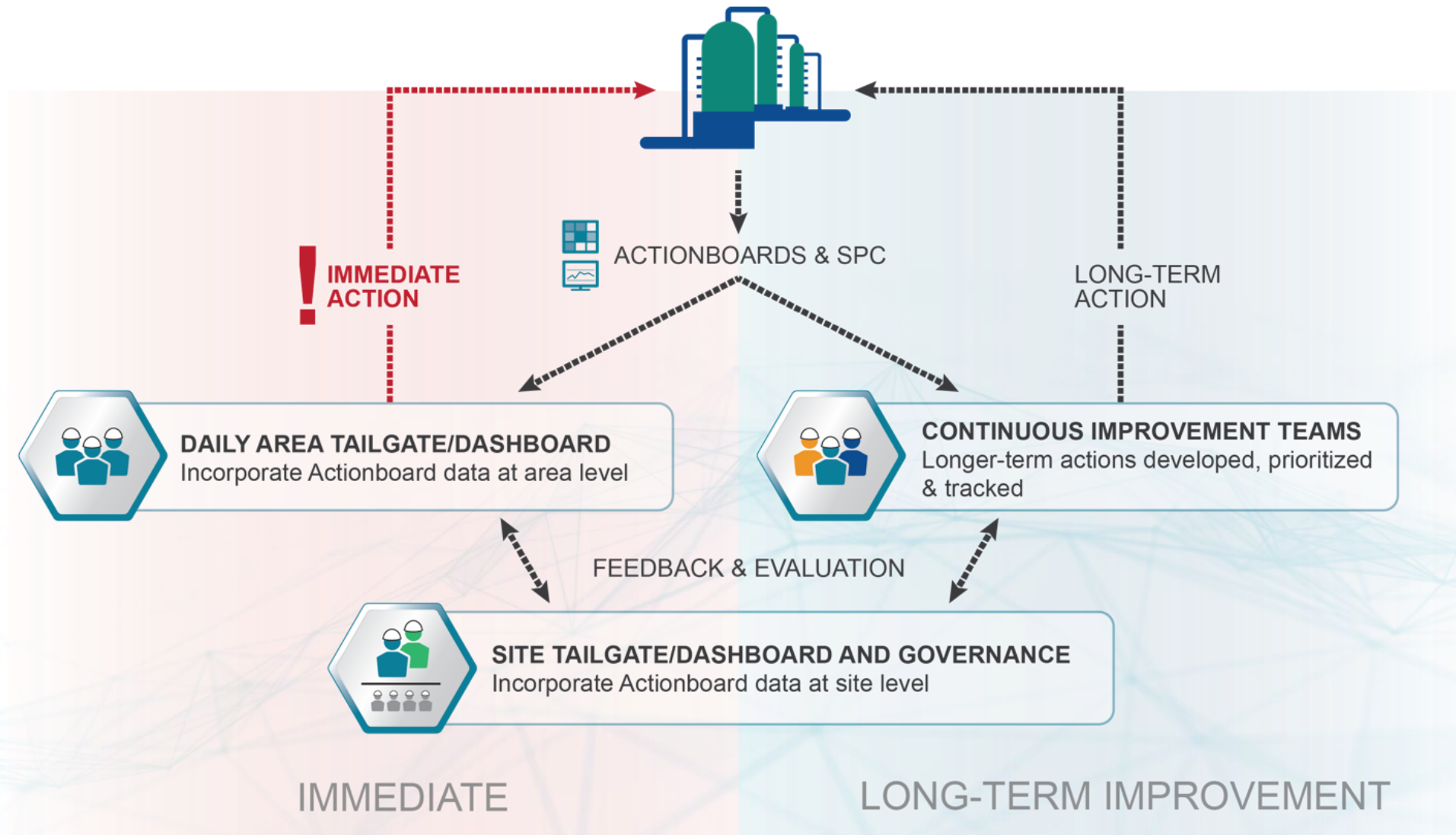
Northwest
Analytics

Albemarle

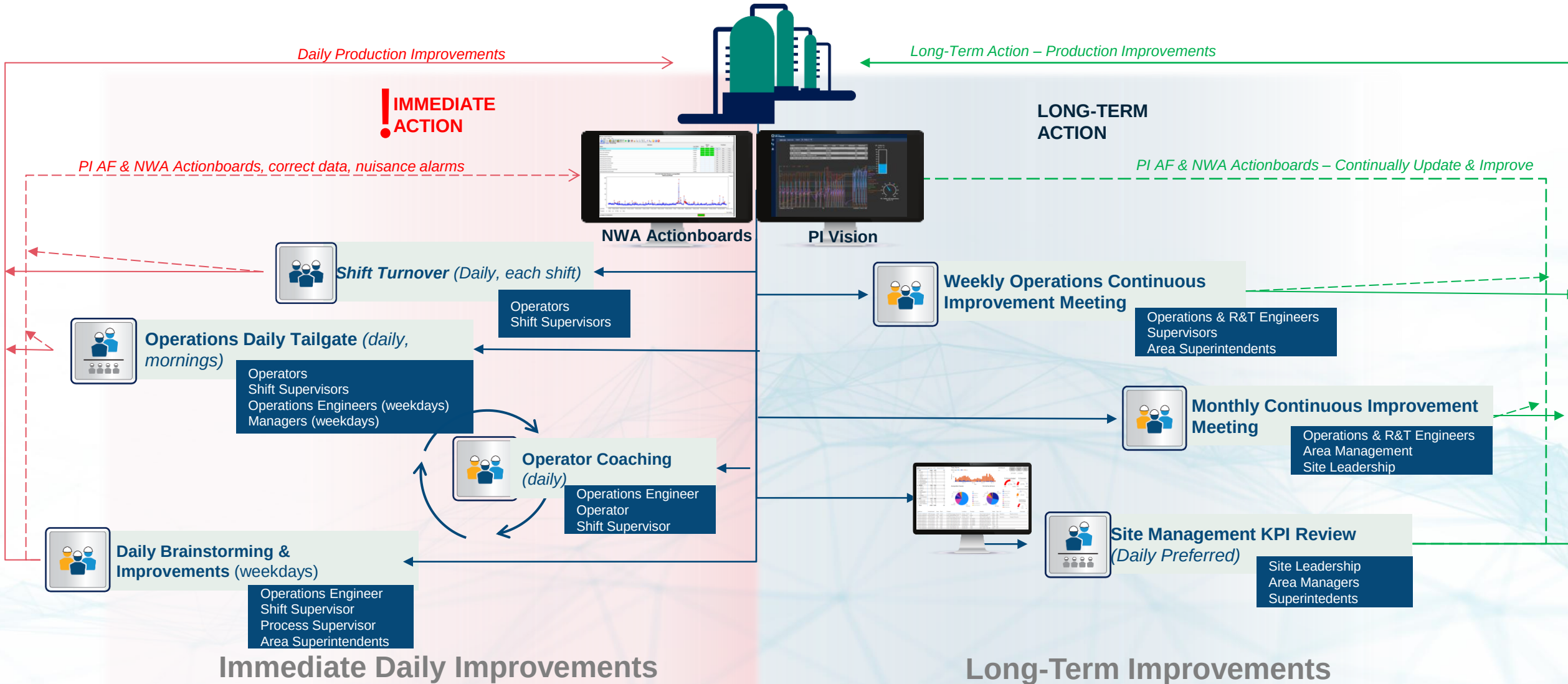
Proprietary information – all rights reserved.

ALBEMARLE INTELLIGENCE

AI-Powered Continuous Improvement



Actionboard Standard Work – Continuous Improvement

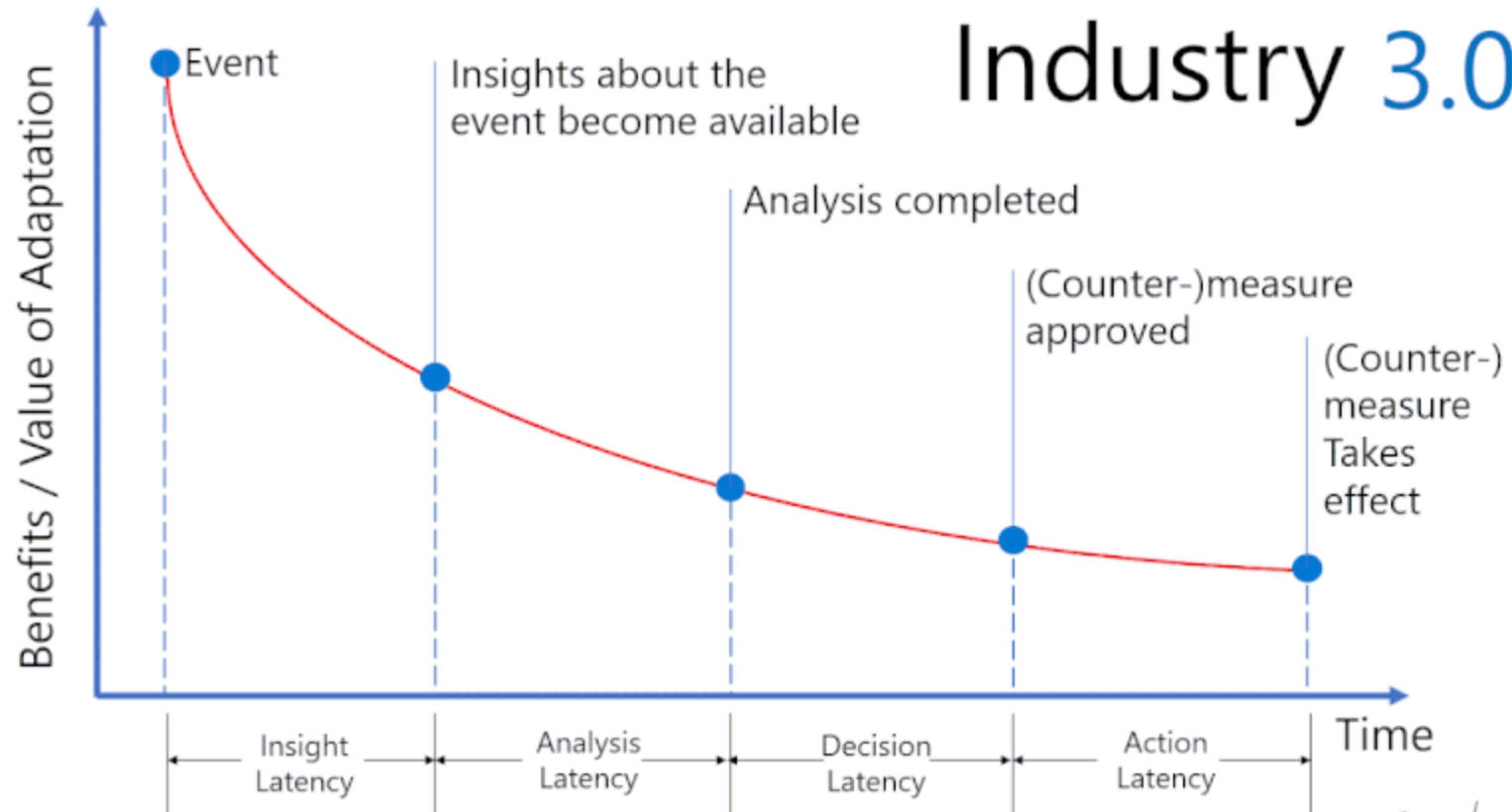


Reason #5

Shiny Object Syndrome

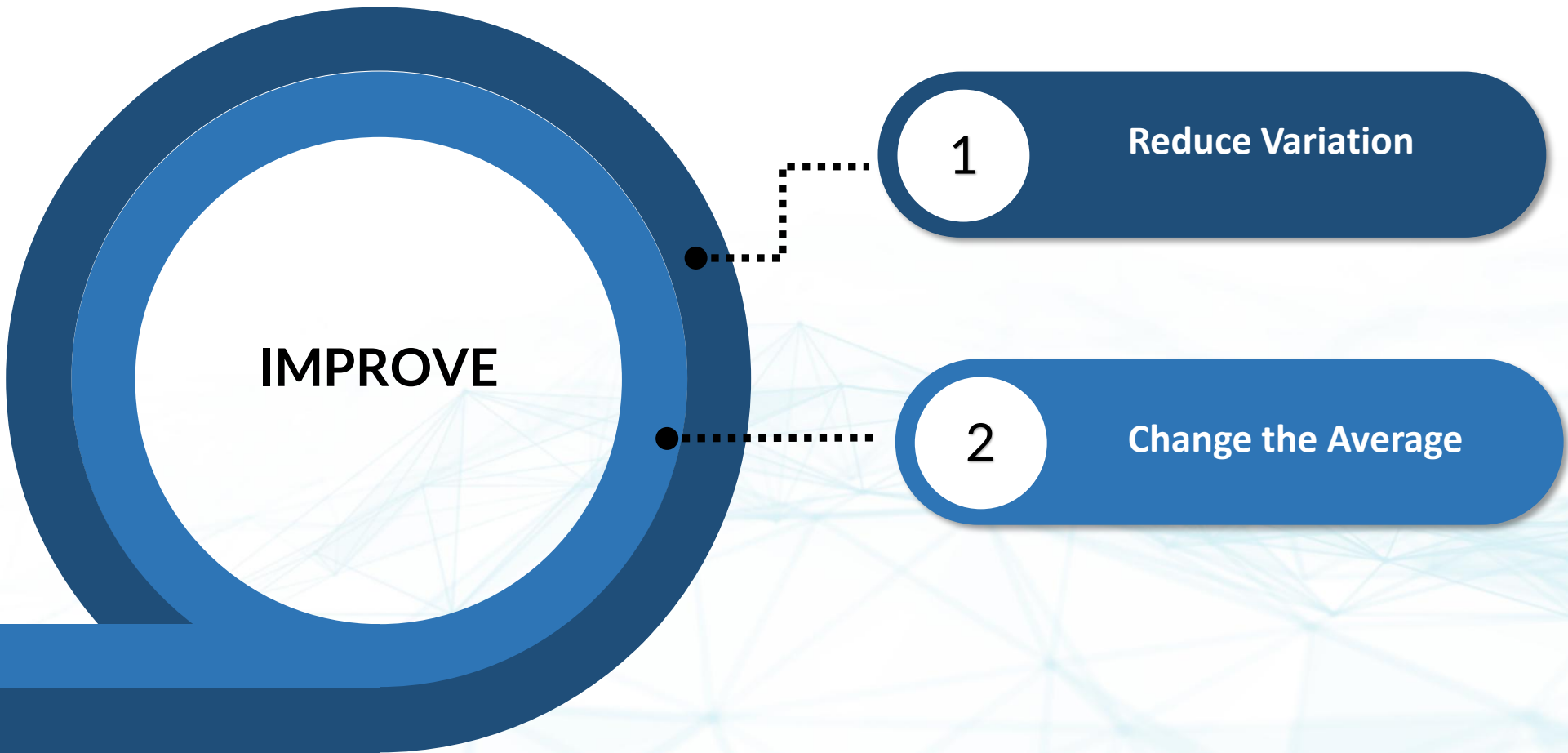
A man in a dark suit with a red tie stands in a large, industrial-style hall with high ceilings and large windows. He is looking up at a massive, glowing orange-red diamond that is the focal point of the scene. The diamond is mounted on a white pedestal and emits a powerful, radiant light that fills the room. Several other smaller, similar diamonds are displayed on white pedestals along the sides of the hall. The floor is highly reflective, mirroring the light from the diamonds and the overhead lights. The overall atmosphere is one of awe and temptation.

Industry 3.0



Source: Acatech's Industrie 4.0 Maturity Index

Jeff Winter



IMPROVE

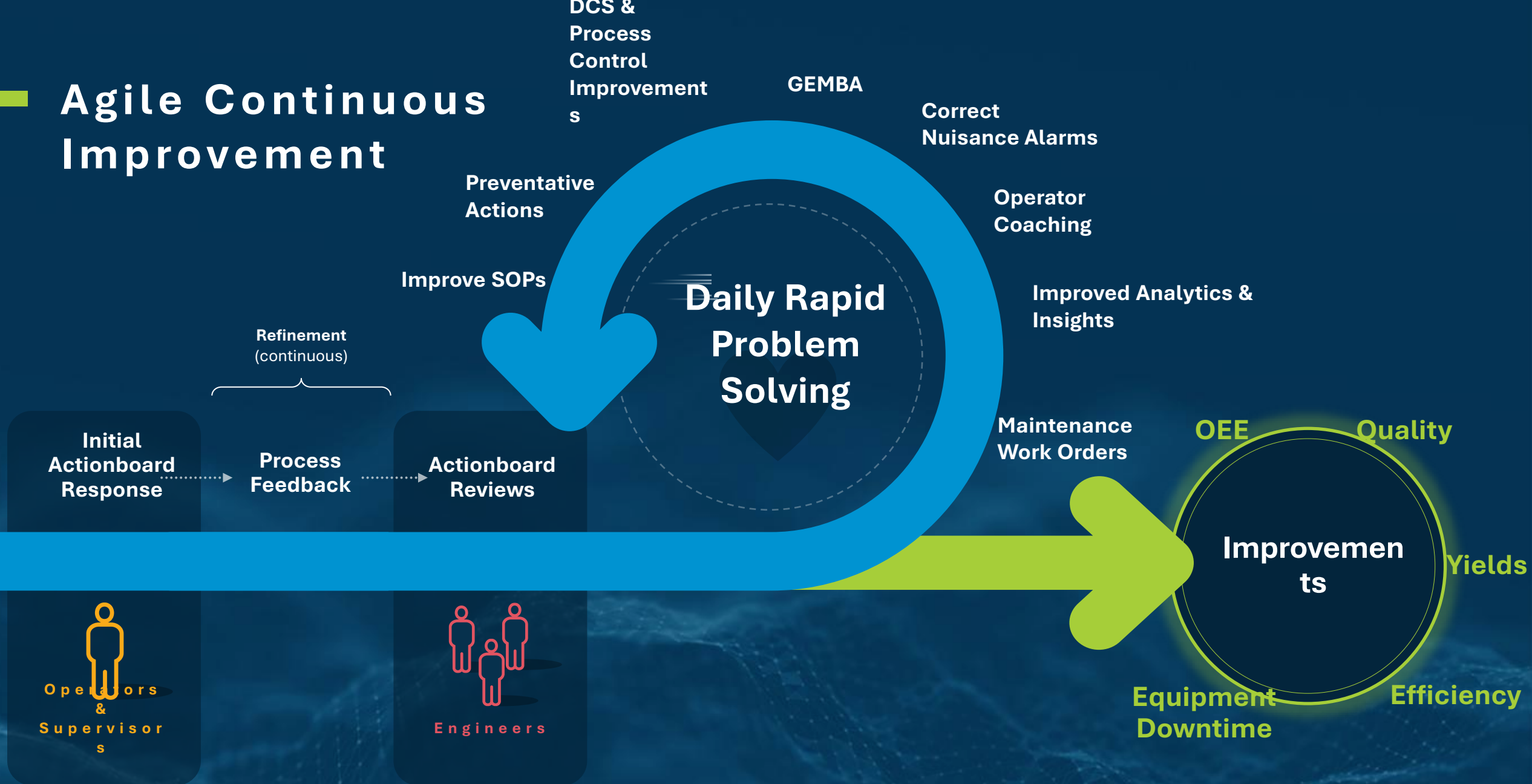
1

Reduce Variation

2

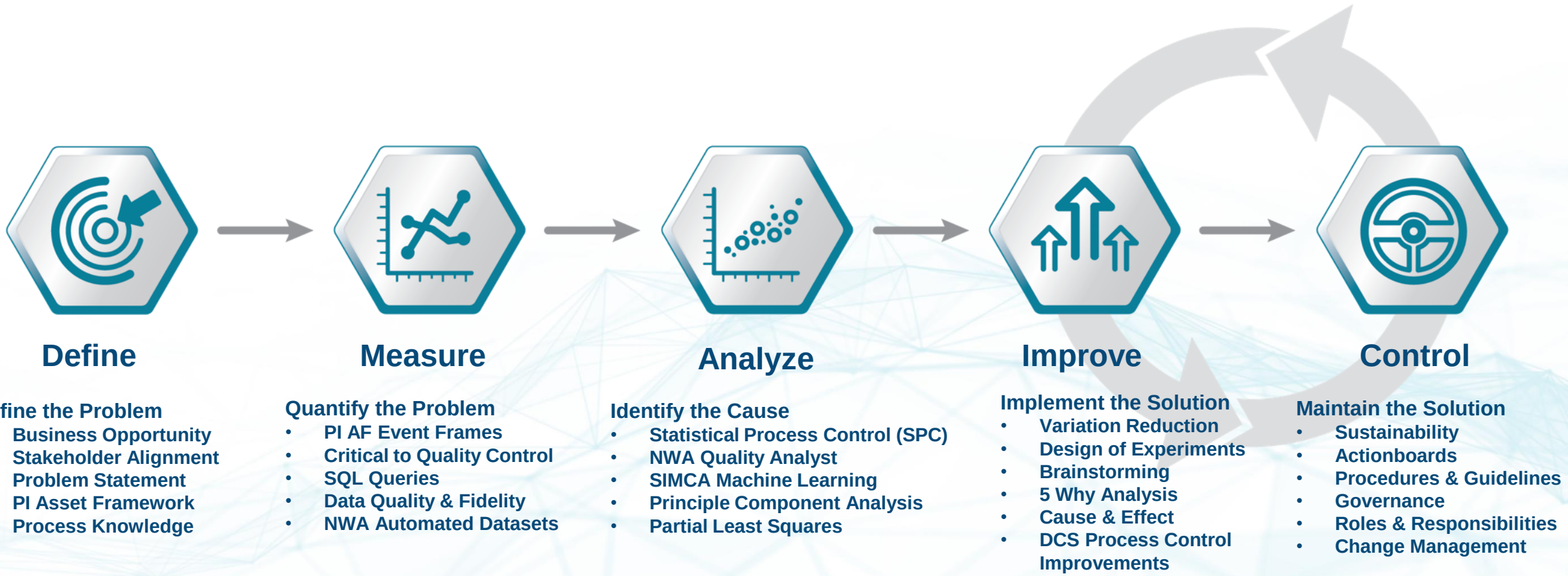
Change the Average

Agile Continuous Improvement

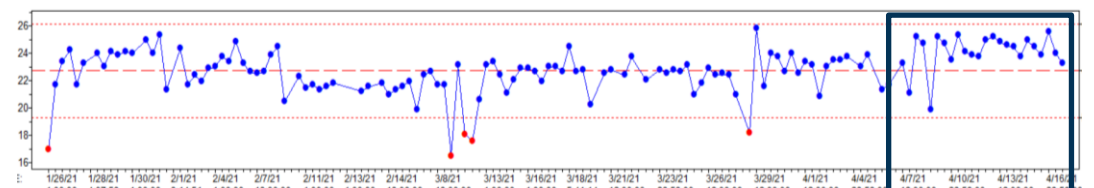
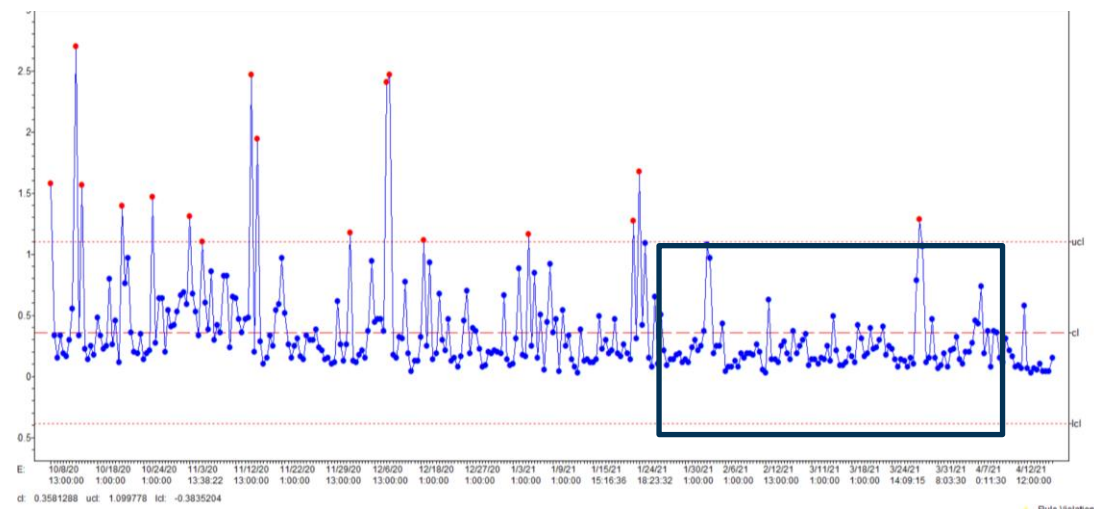
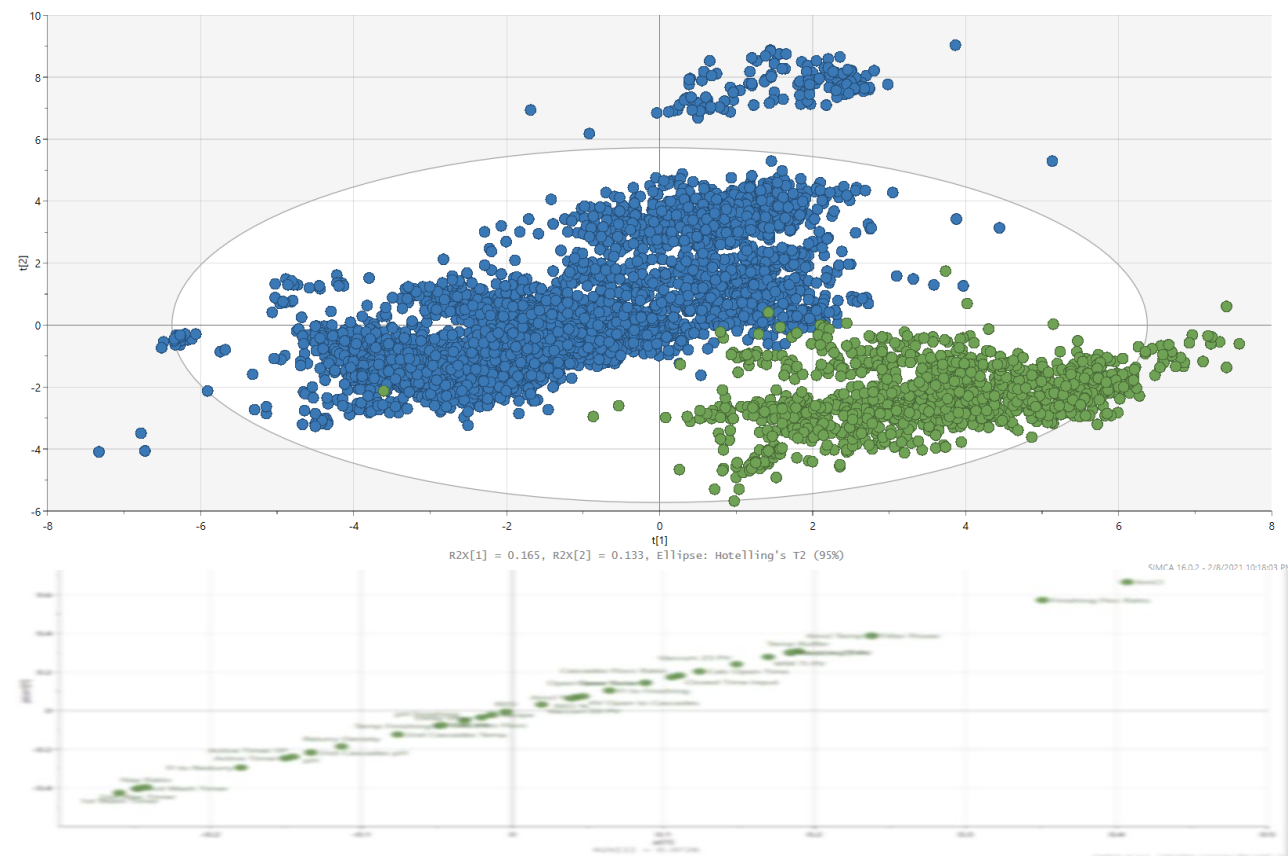


The logo features a stylized head profile on the left, composed of vertical lines and dots, with a blue gear icon positioned above it. To the right of this graphic, the letters "AI" are rendered in a large, bold, blue font. Further to the right, the words "ALBEMARLE" and "INTELLIGENCE" are stacked vertically in a grey, sans-serif font.

AI ALBEMARLE INTELLIGENCE

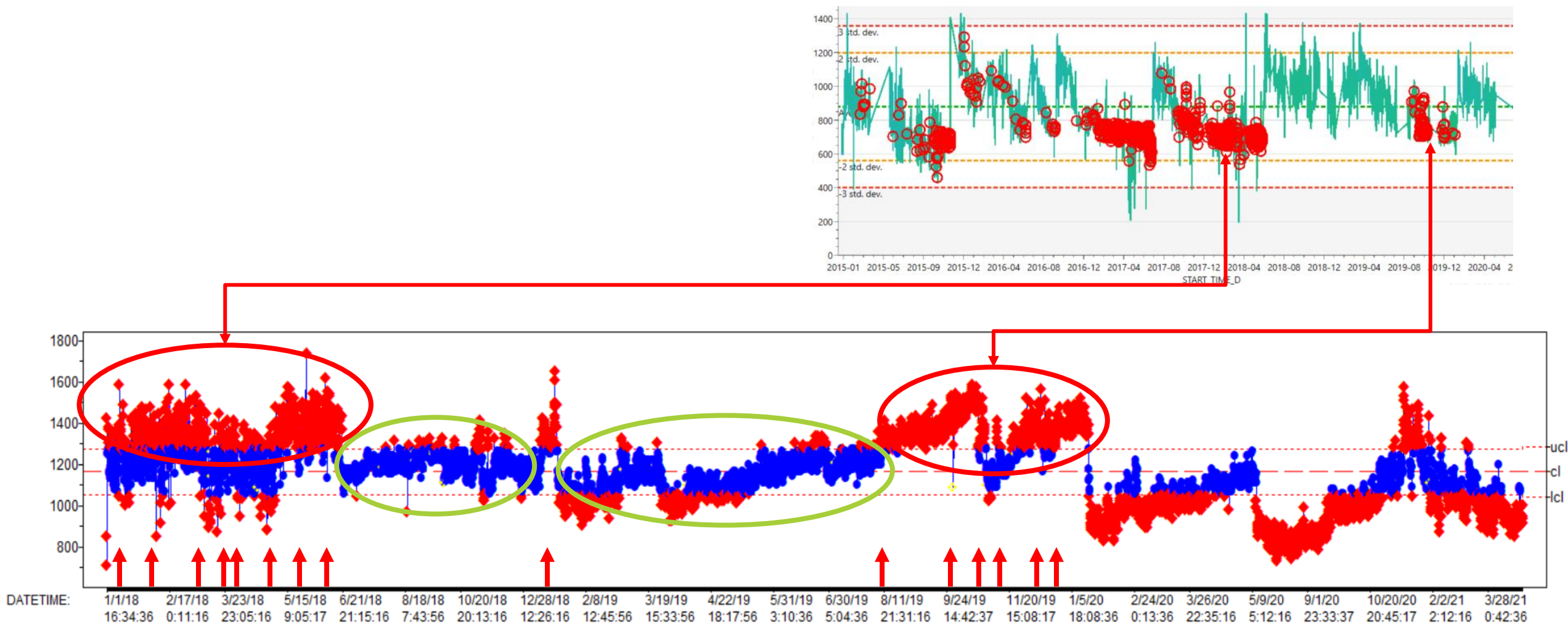


Albemarle Intelligence – Engineer Improvement Project

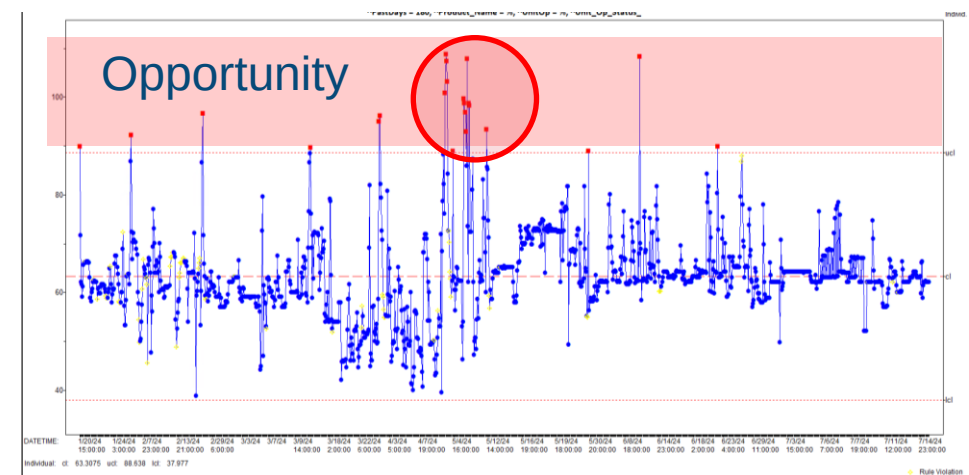
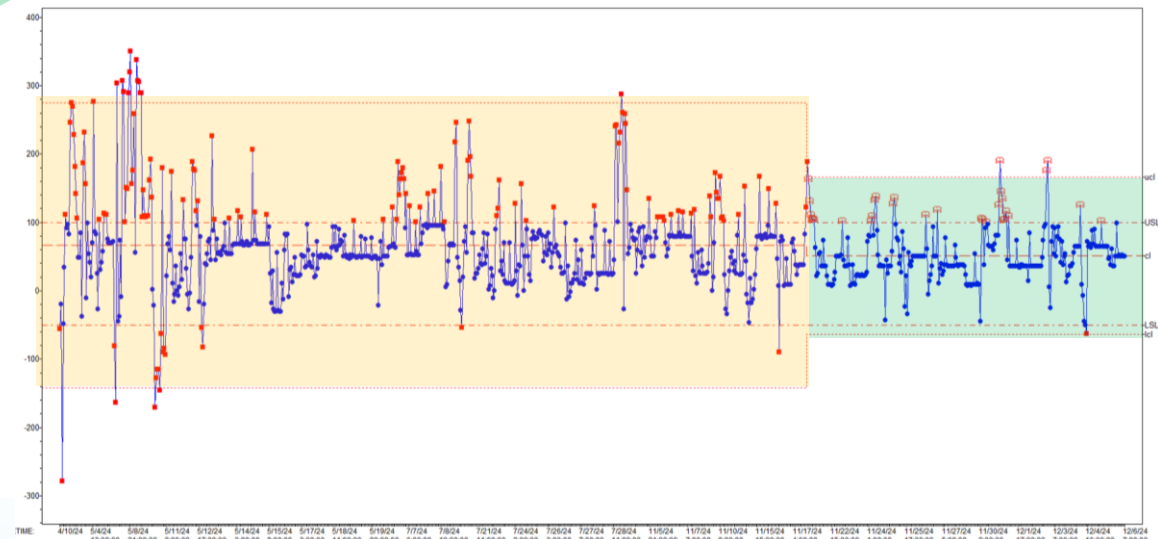
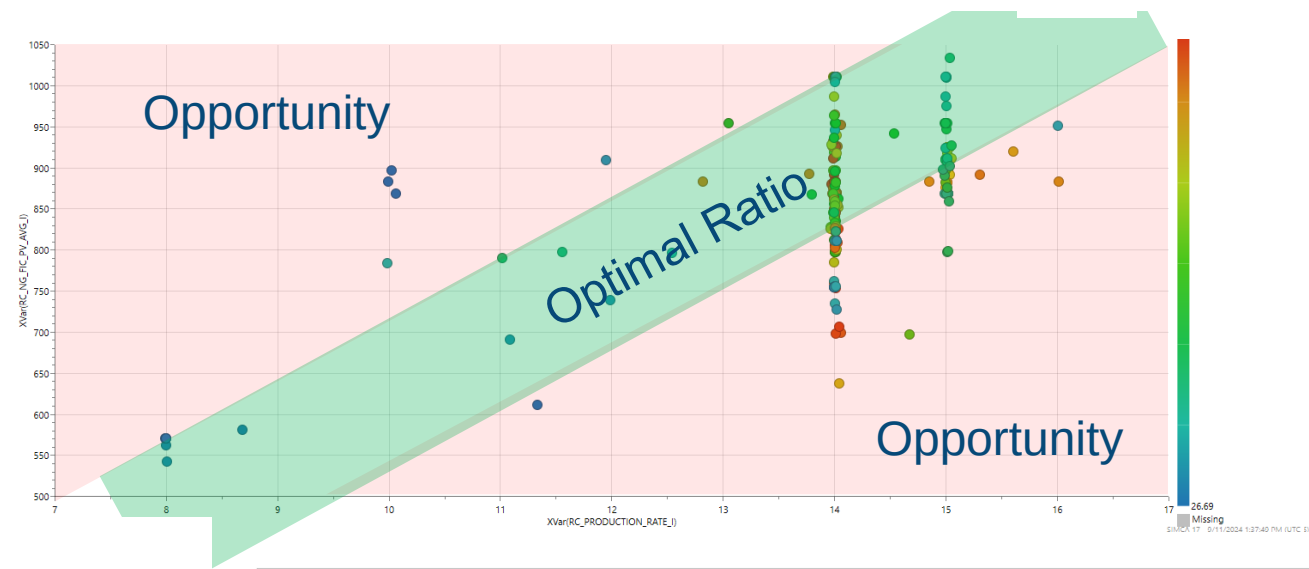




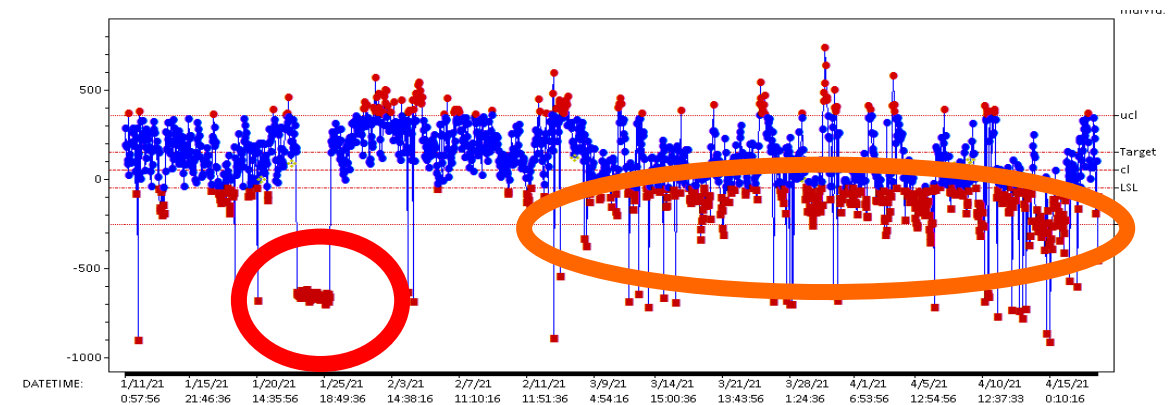
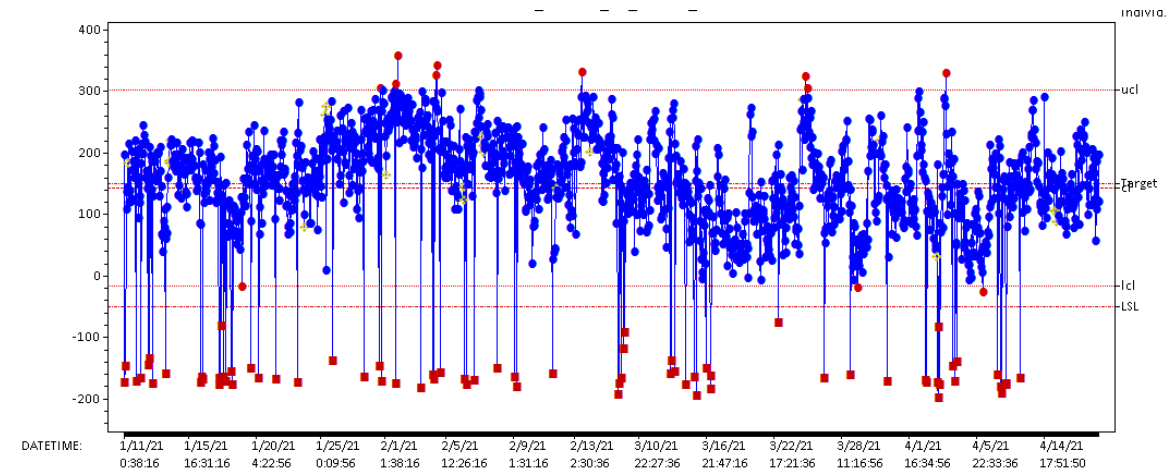
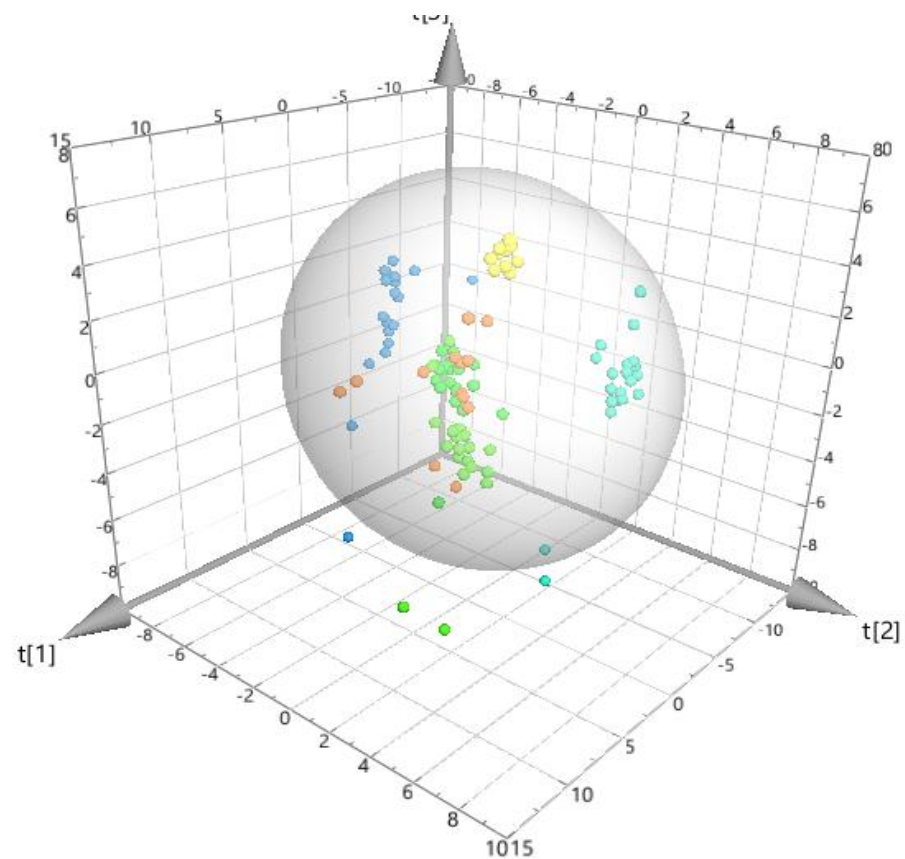
Albemarle Intelligence – Engineer Improvement Project



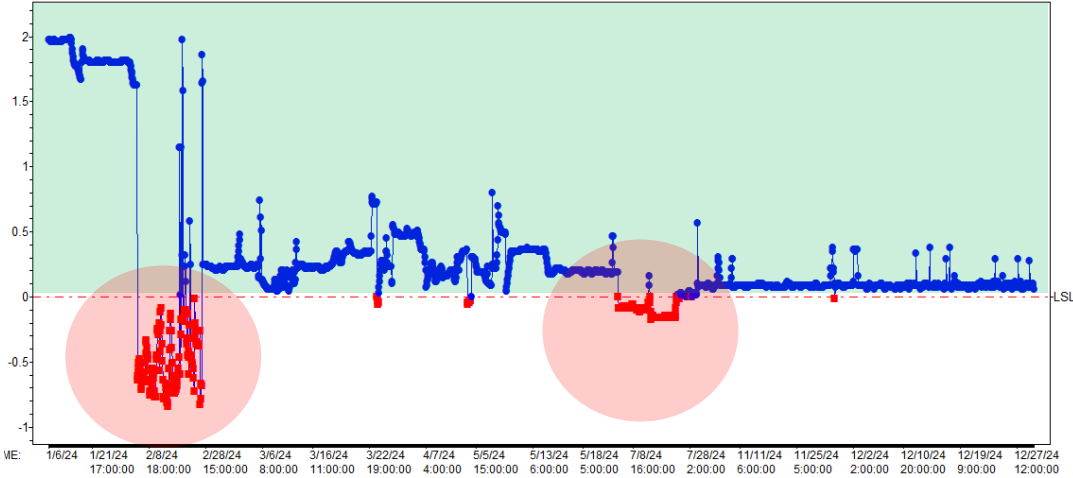
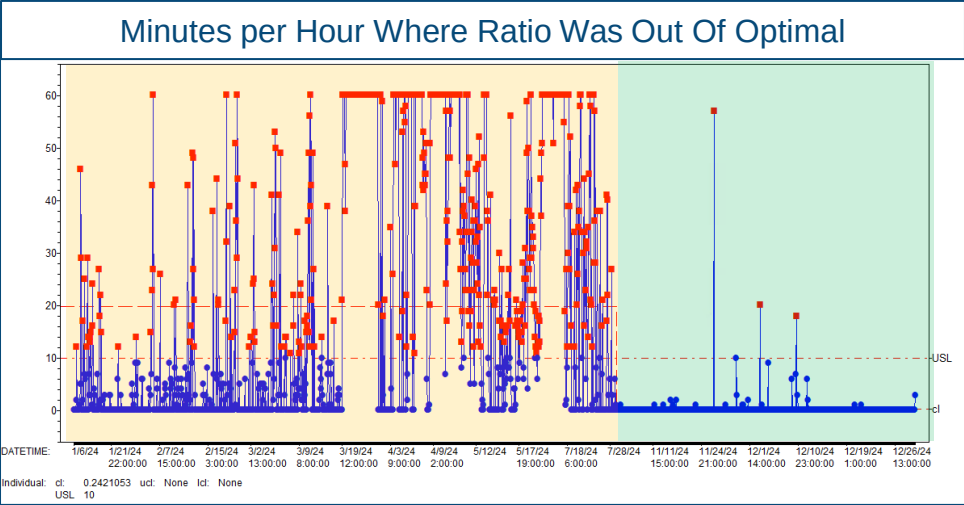
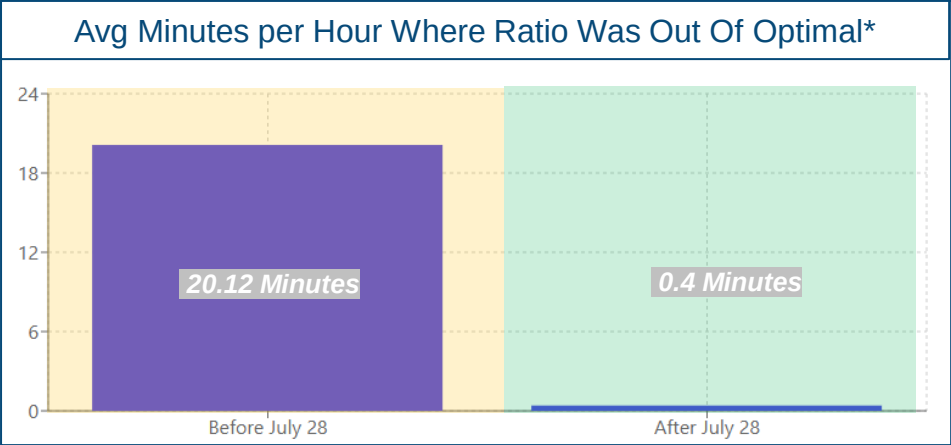
Albemarle Intelligence – Engineer Improvement Project



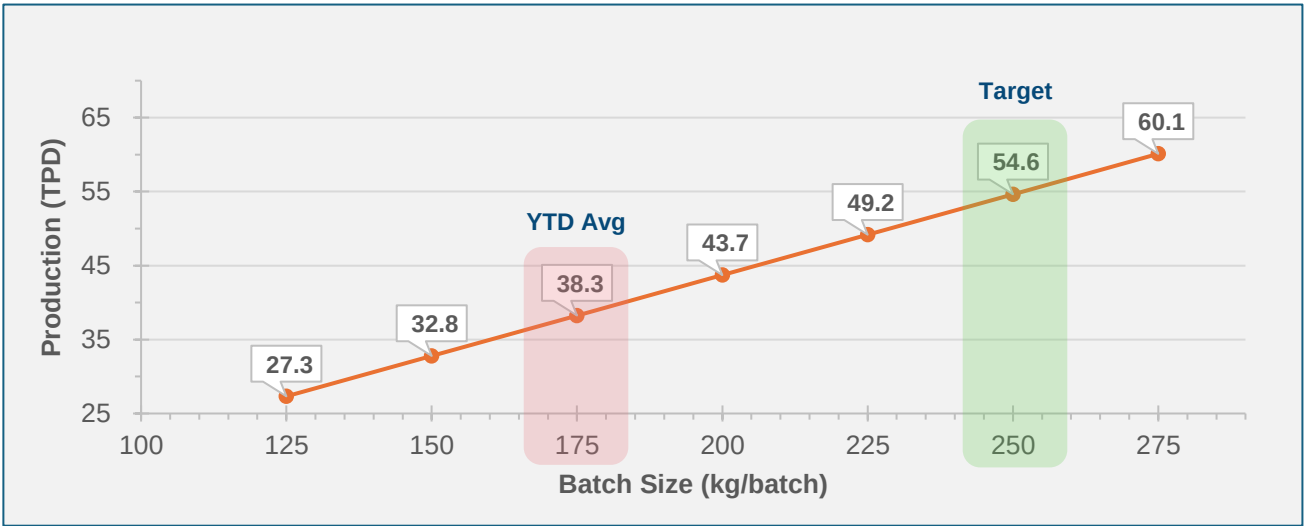
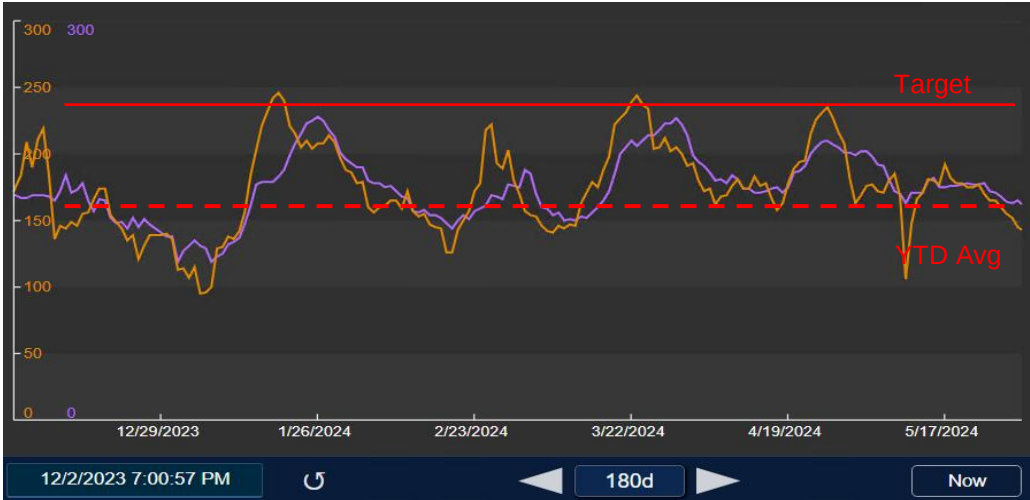
Albemarle Intelligence – Engineer Improvement Project



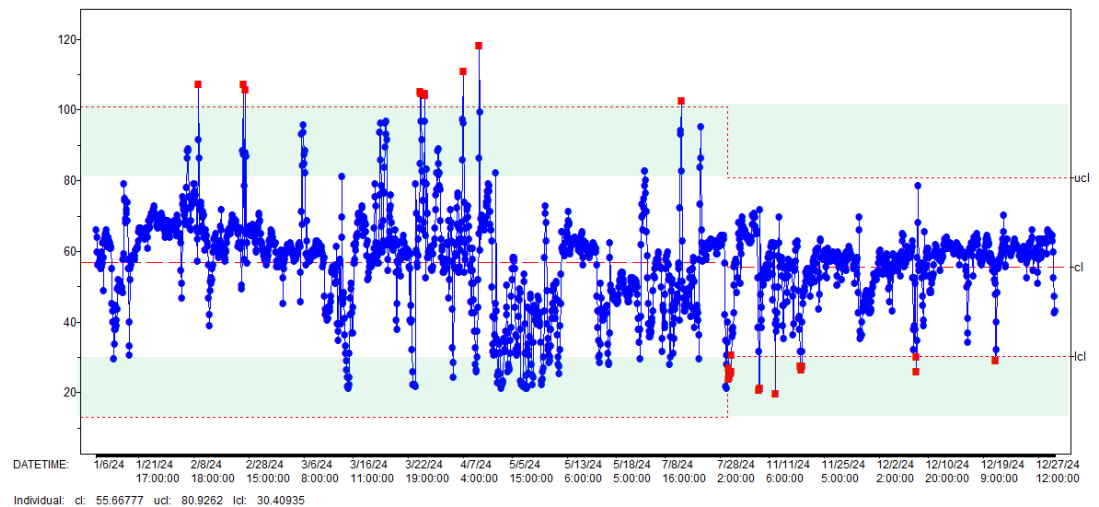
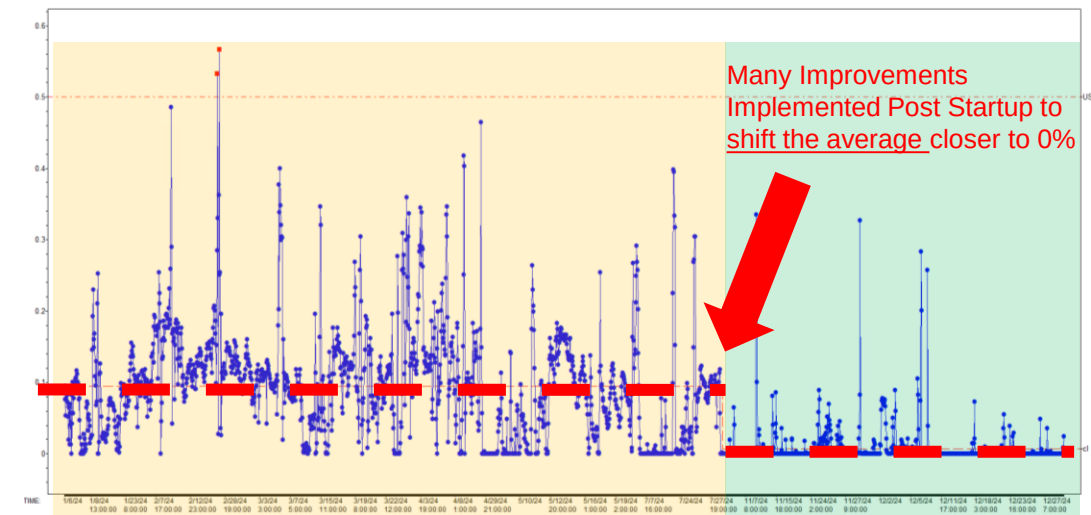
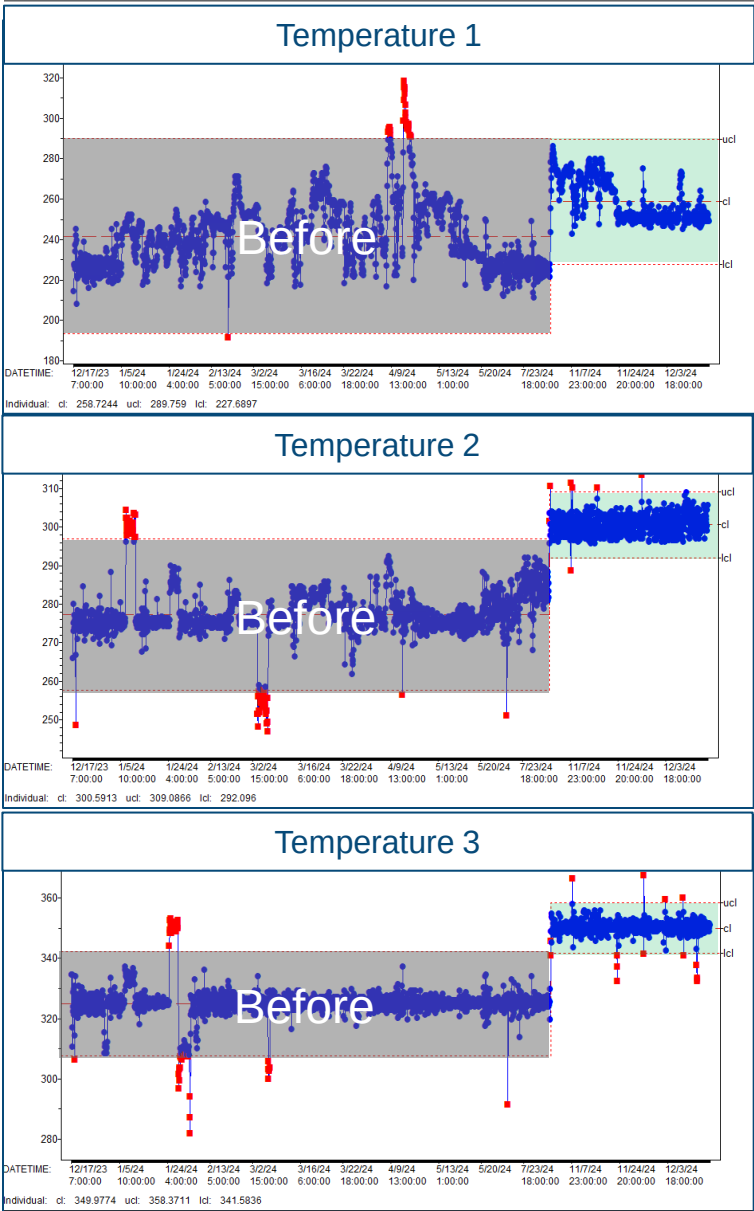
Albemarle Intelligence – Engineer Improvement Project



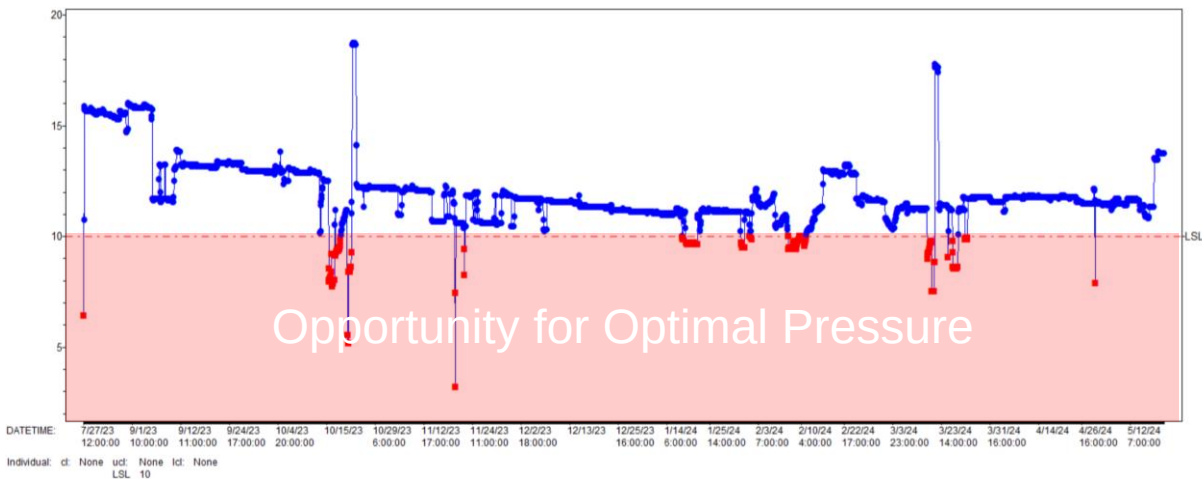
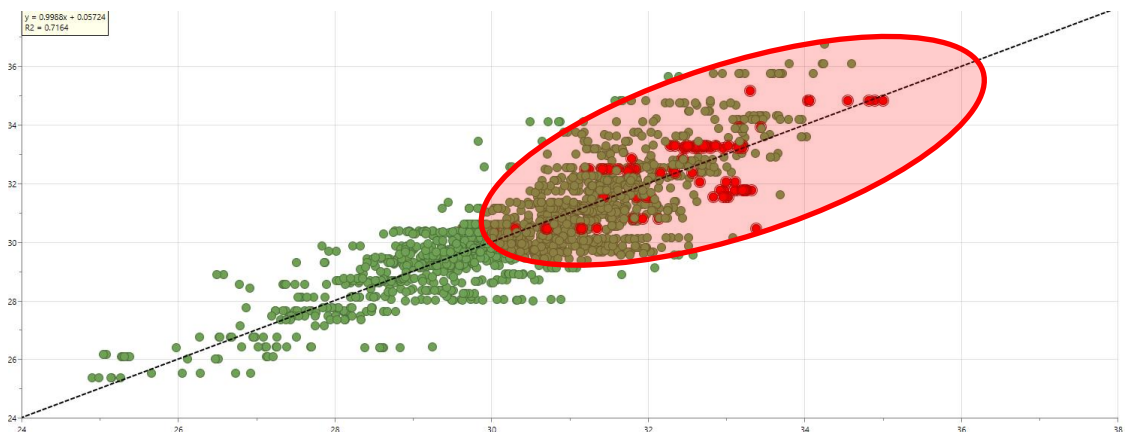
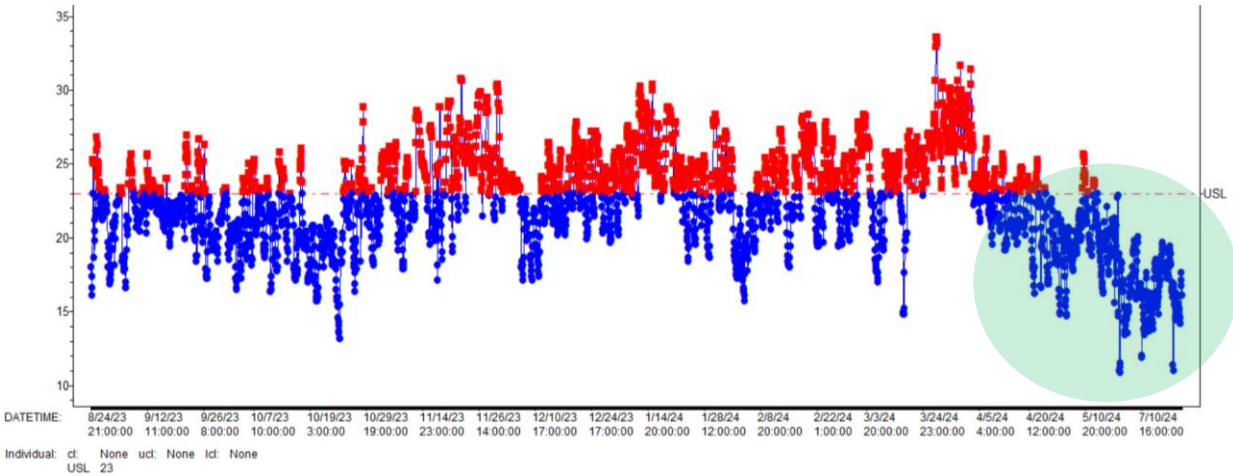
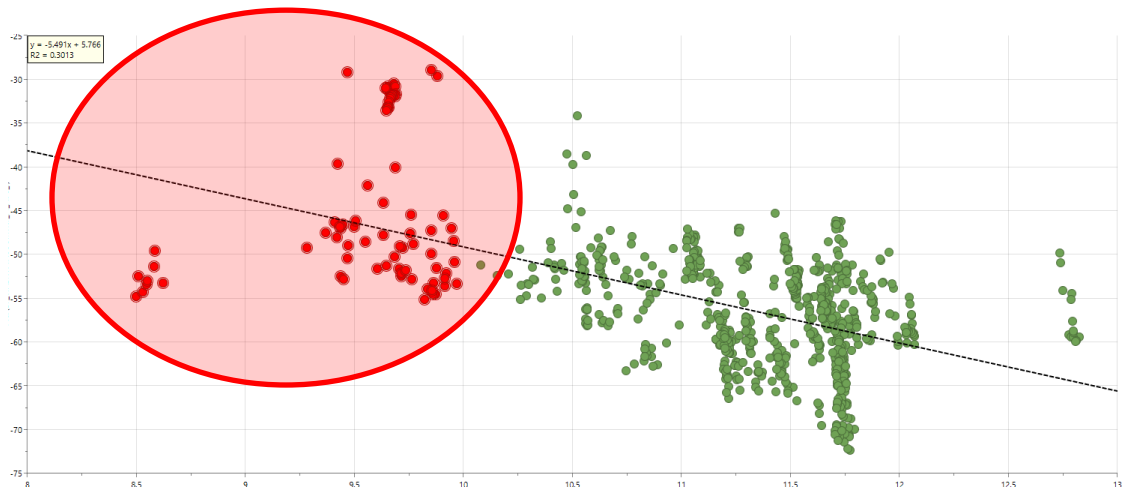
Albemarle Intelligence – Engineer Improvement Project



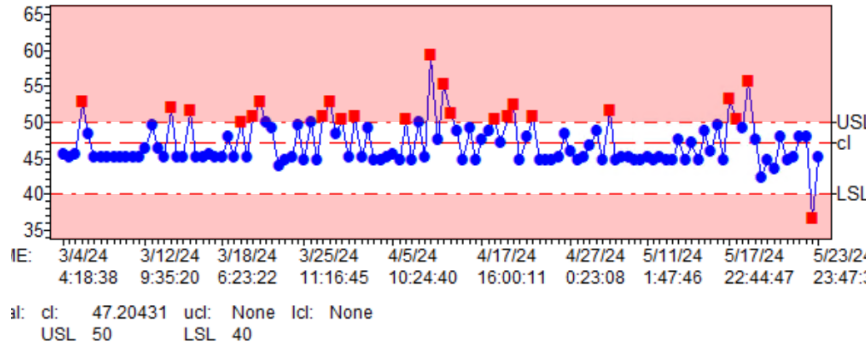
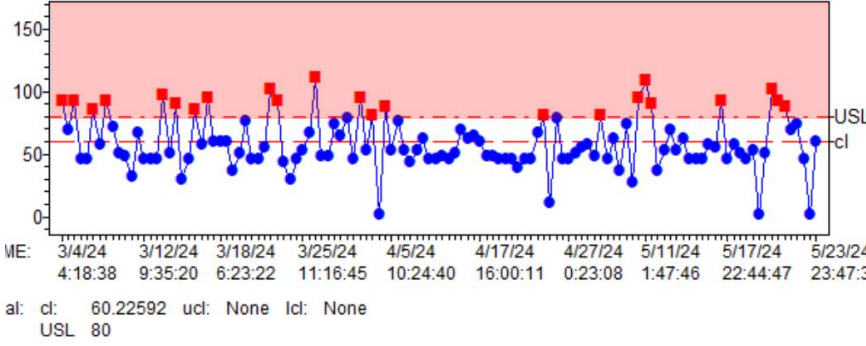
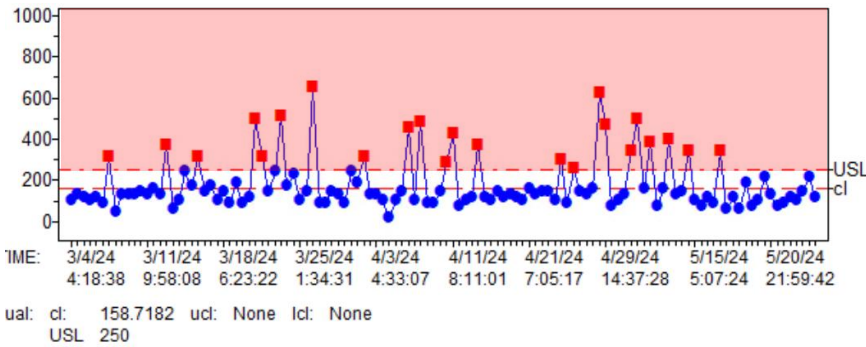
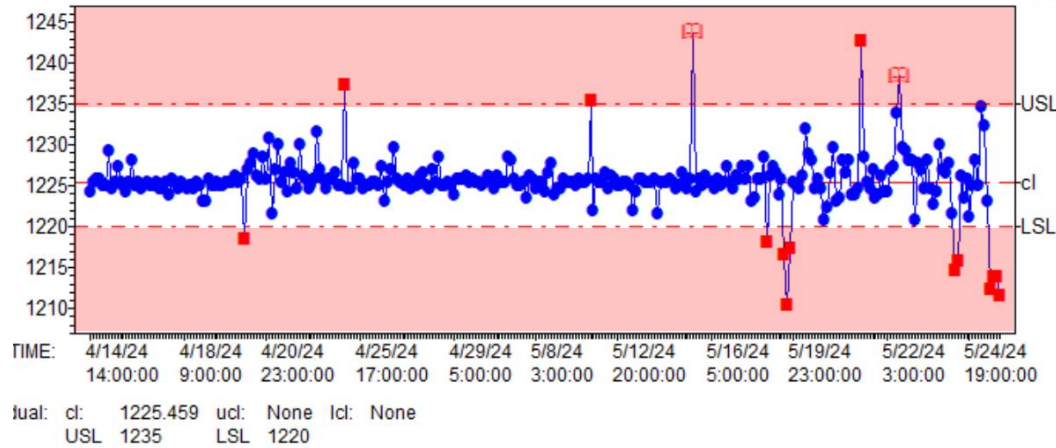
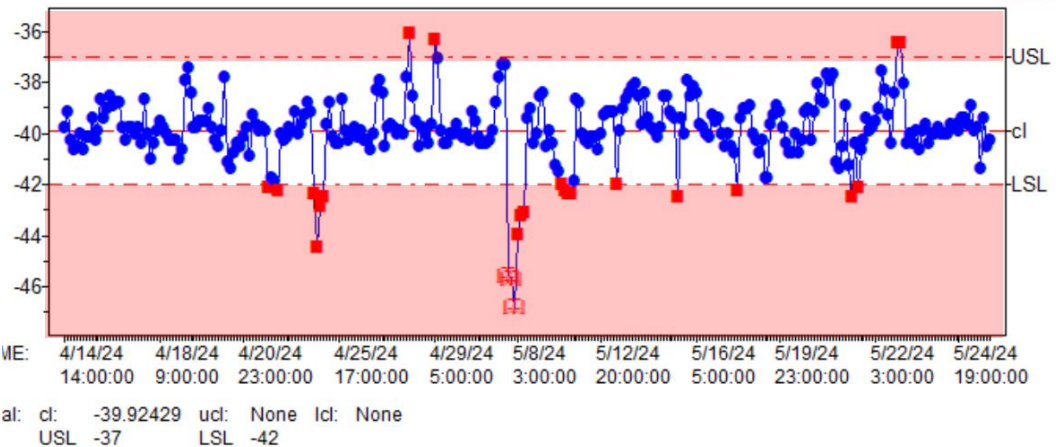
Albemarle Intelligence – Engineer Improvement Project



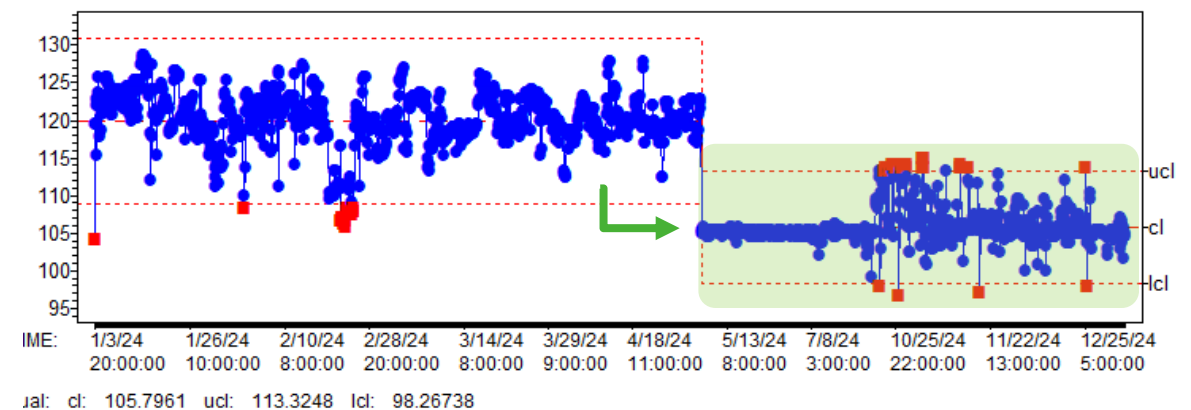
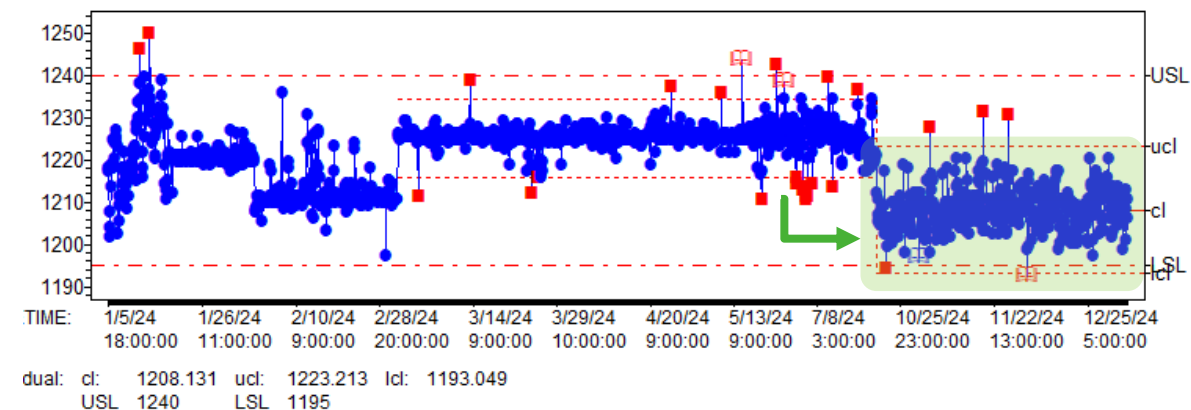
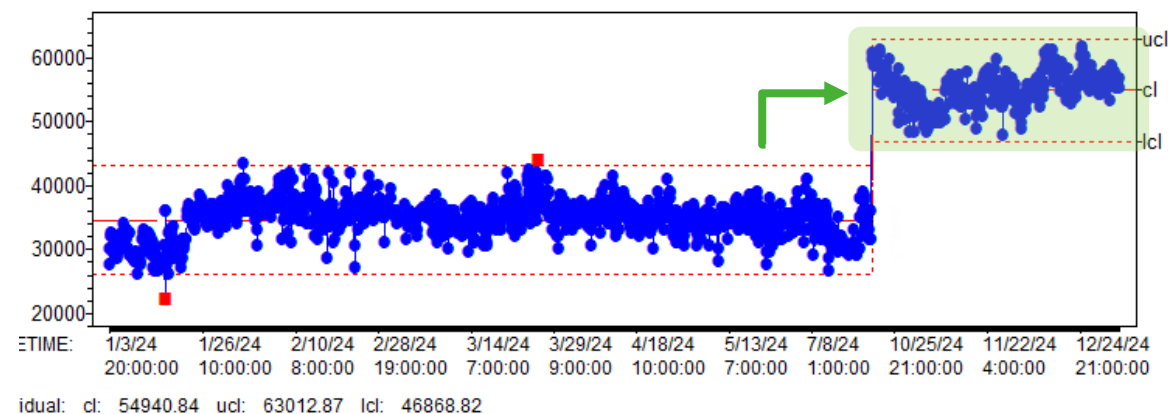
Albemarle Intelligence – Engineer Improvement Project



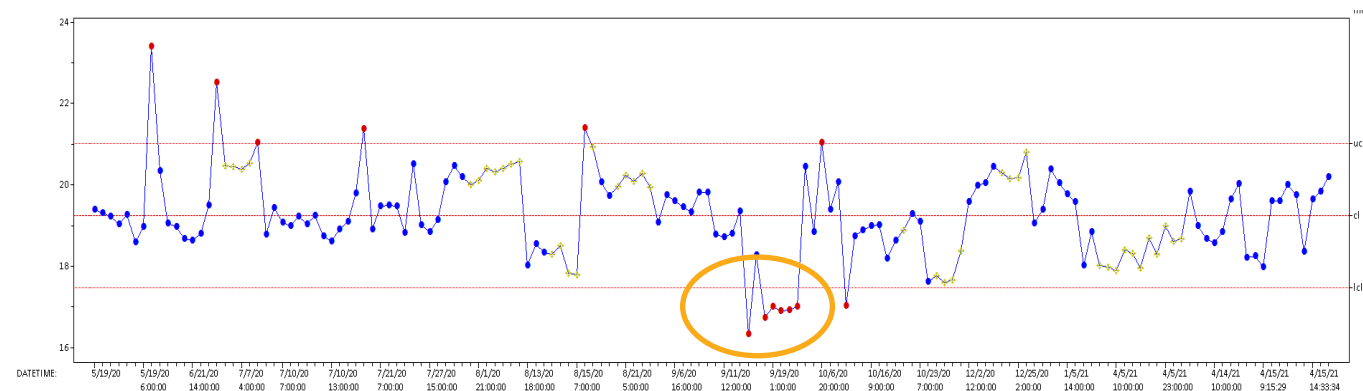
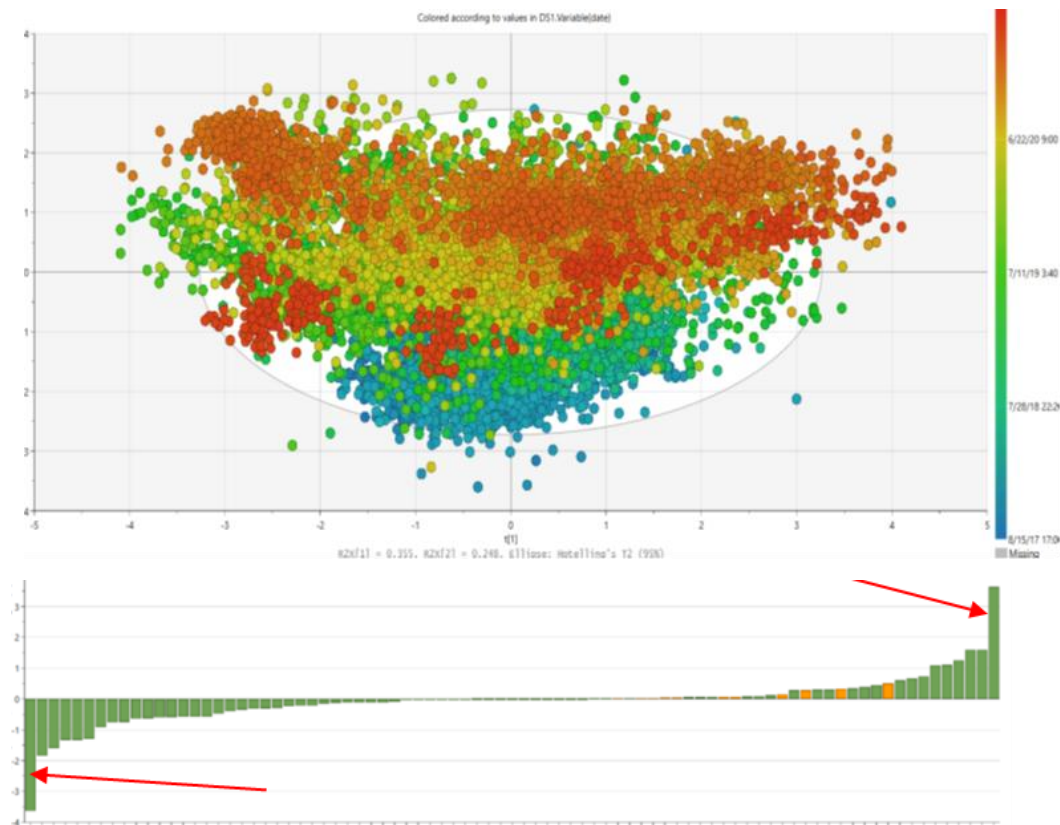
Albemarle Intelligence – Engineer Improvement Project



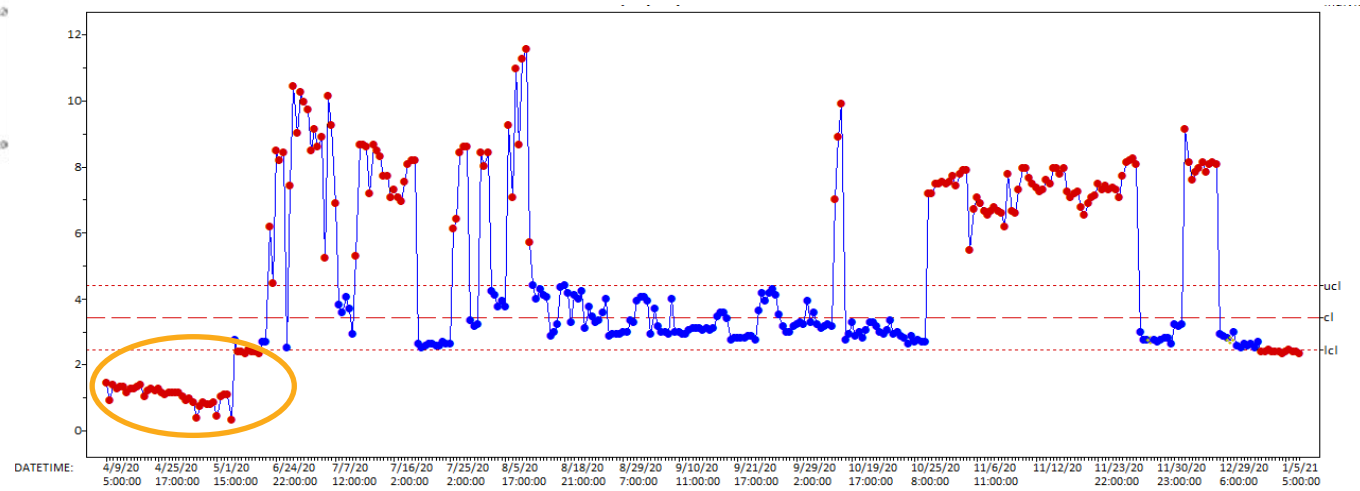
Albemarle Intelligence – Engineer Improvement Project



Albemarle Intelligence – Engineer Improvement Project



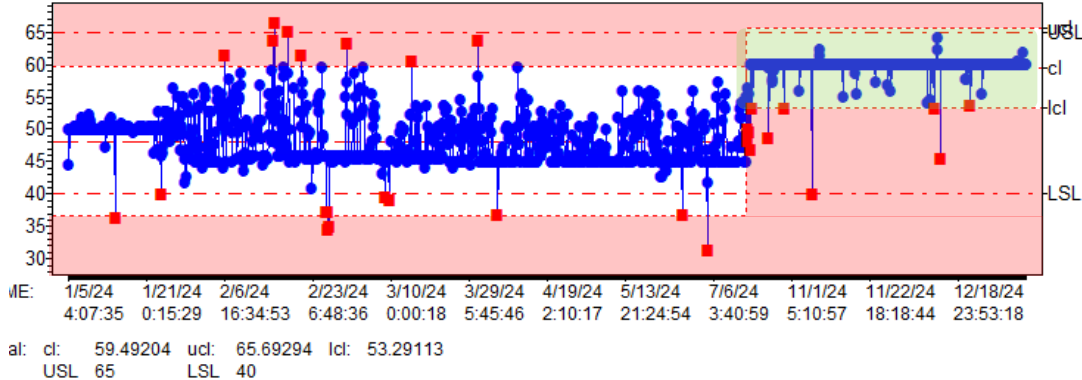
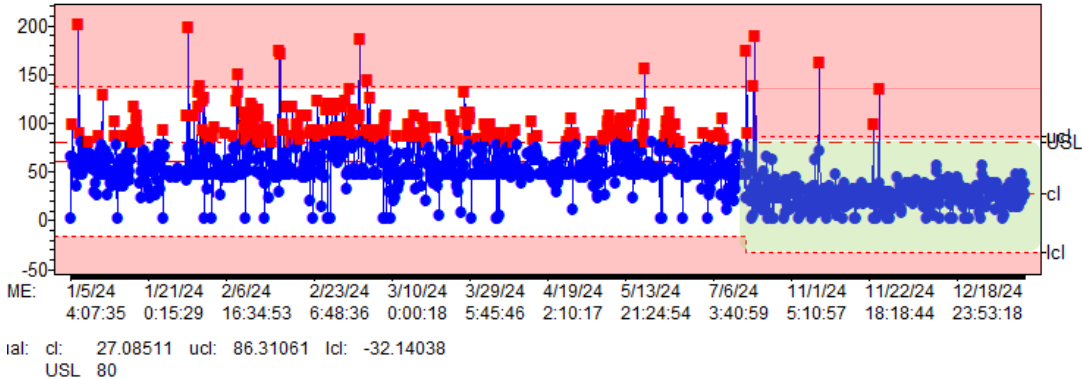
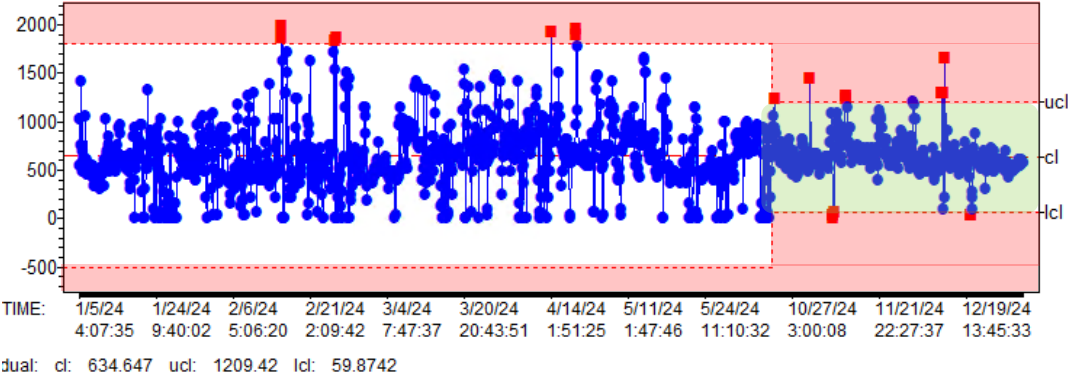
Individual: cl: 19.24363 ucl: 21.02034 lcl: 17.46692



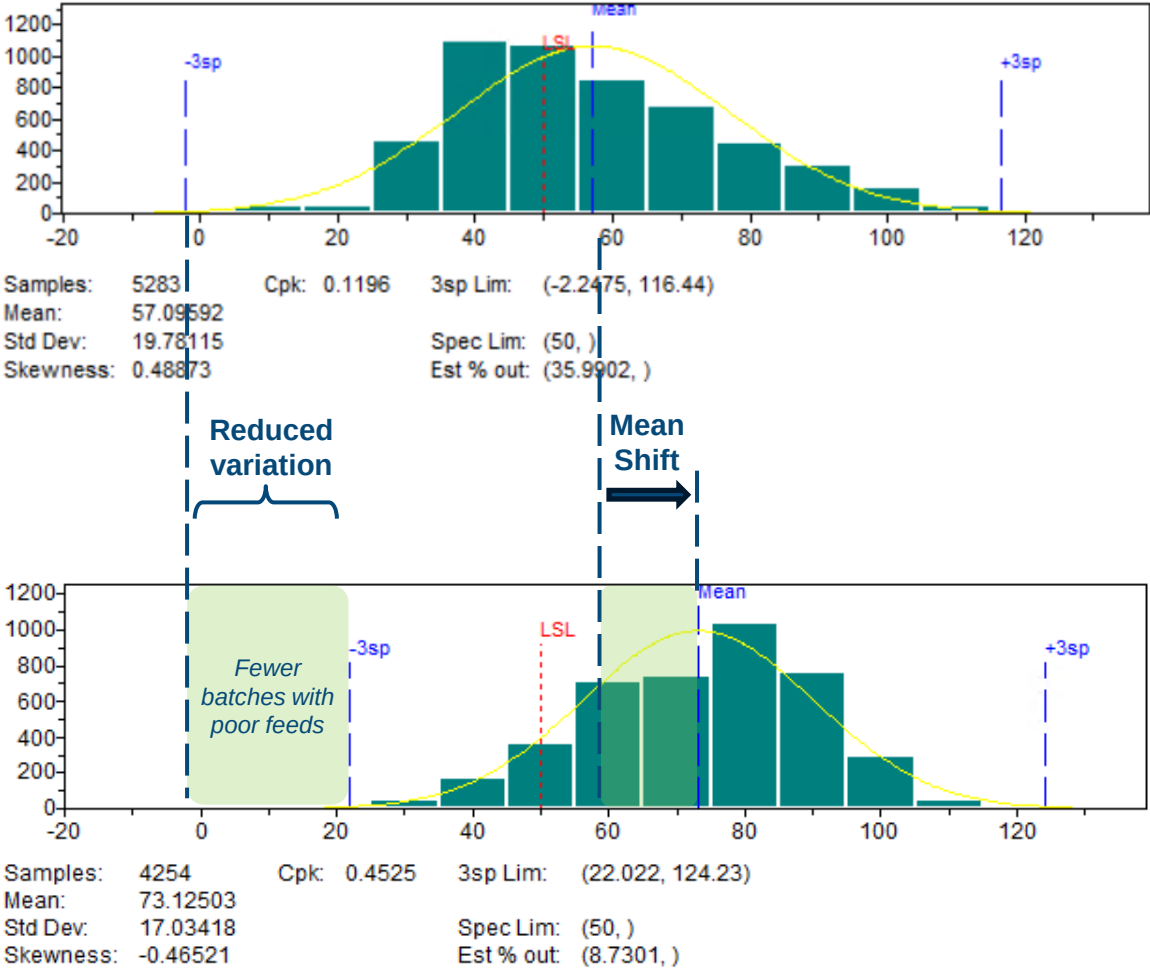
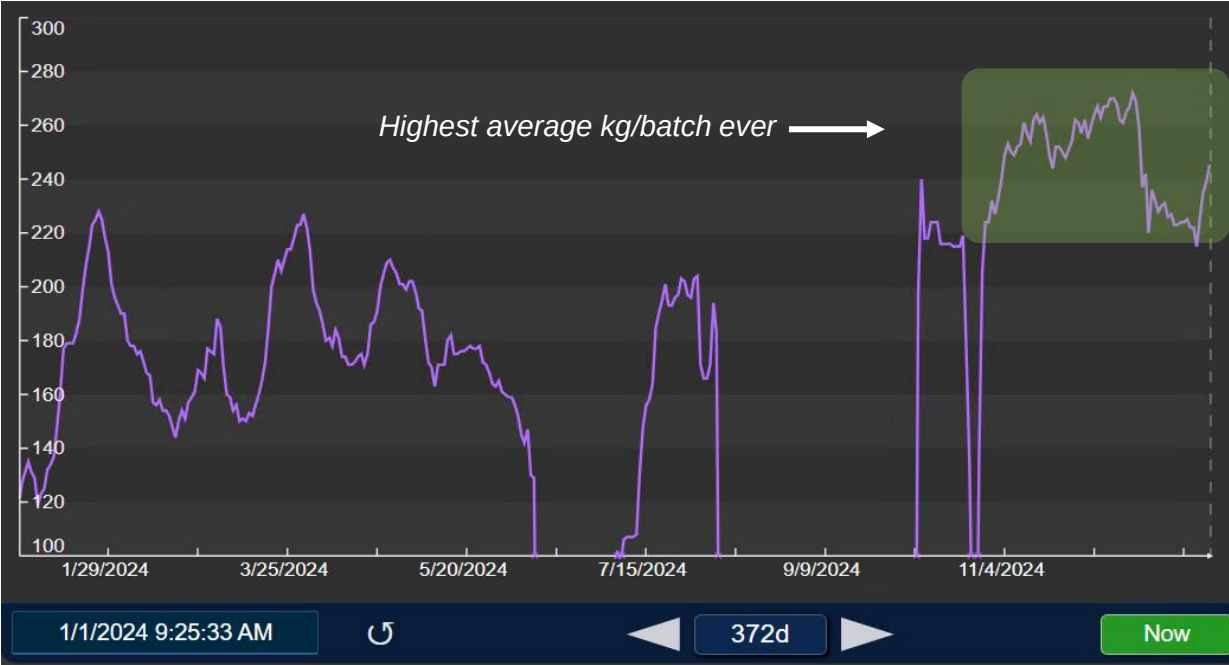
Individual: cl: 3.432336 ucl: 4.420047 lcl: 2.444624

Rule Violation

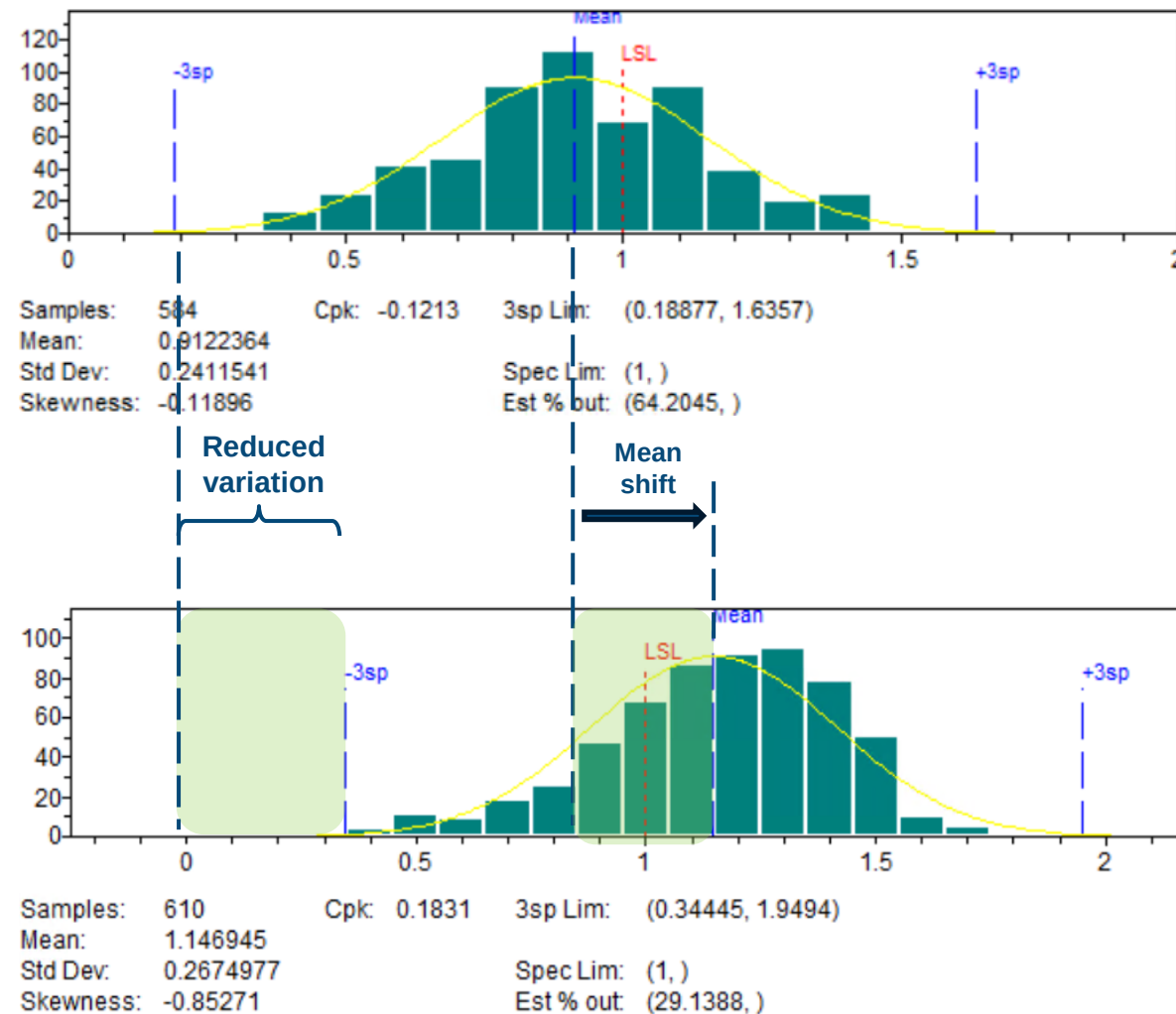
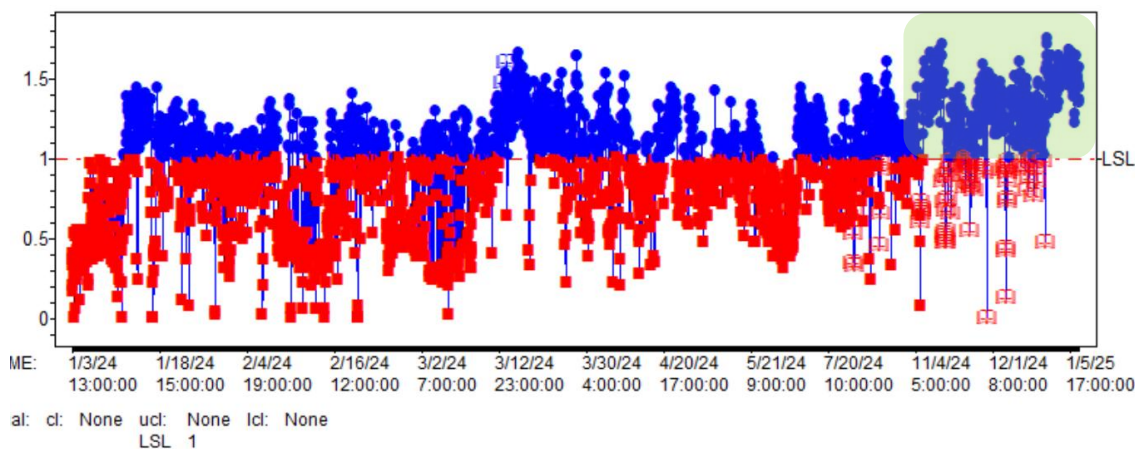
Albemarle Intelligence – Engineer Improvement Project



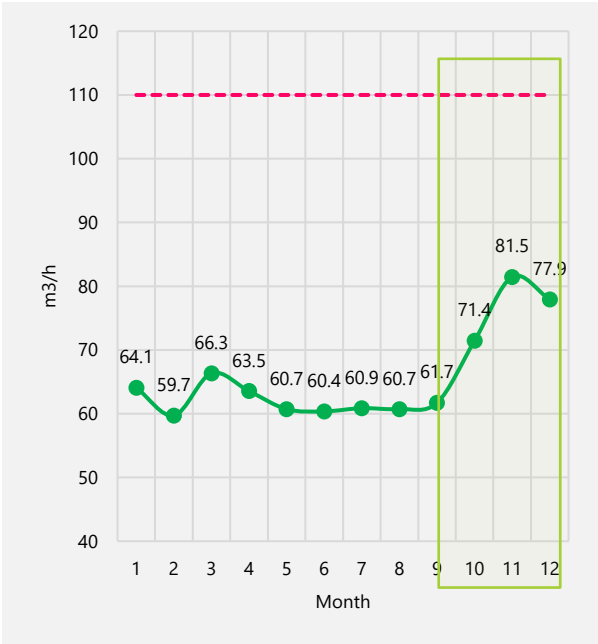
Albemarle Intelligence – Engineer Improvement Project



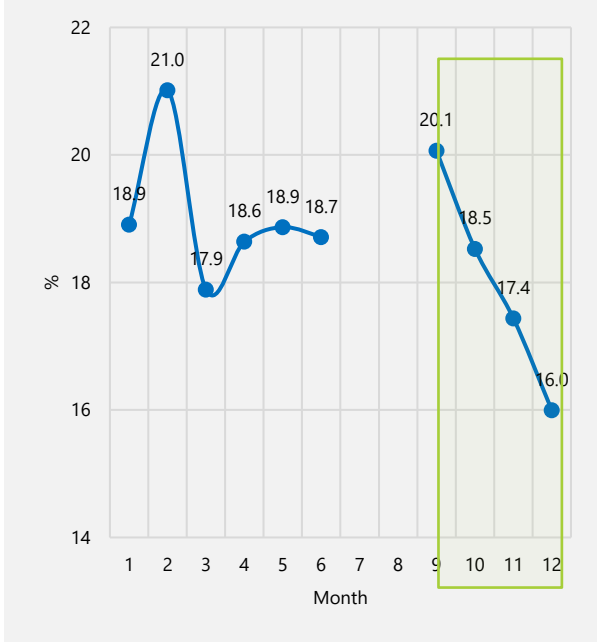
Albemarle Intelligence – Engineer Improvement Project



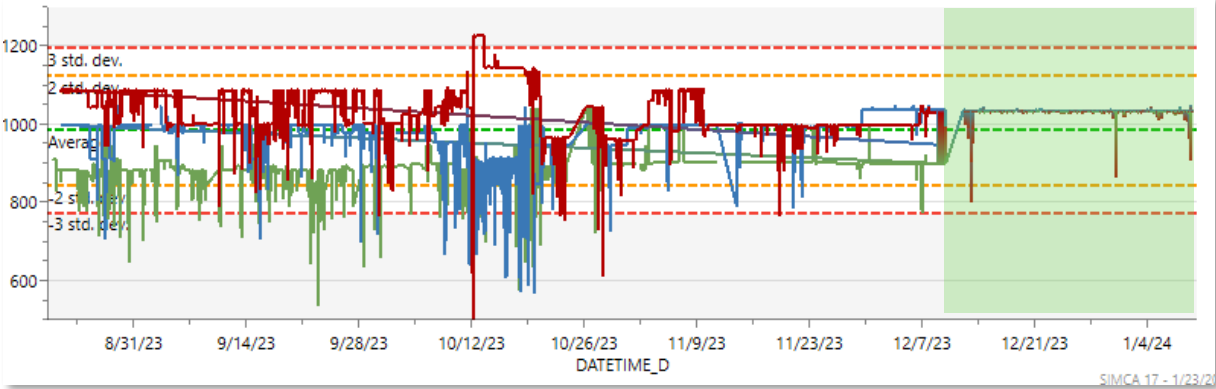
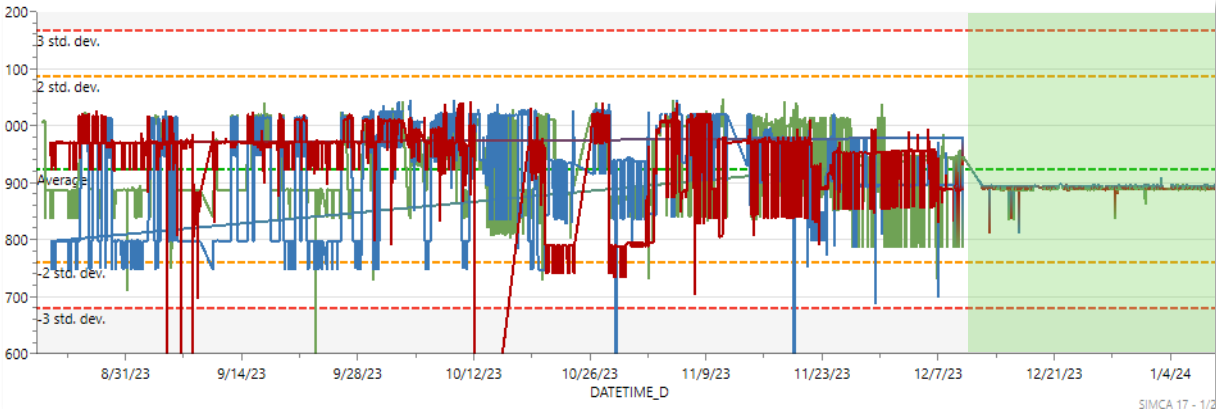
Albemarle Intelligence – Engineer Improvement Project



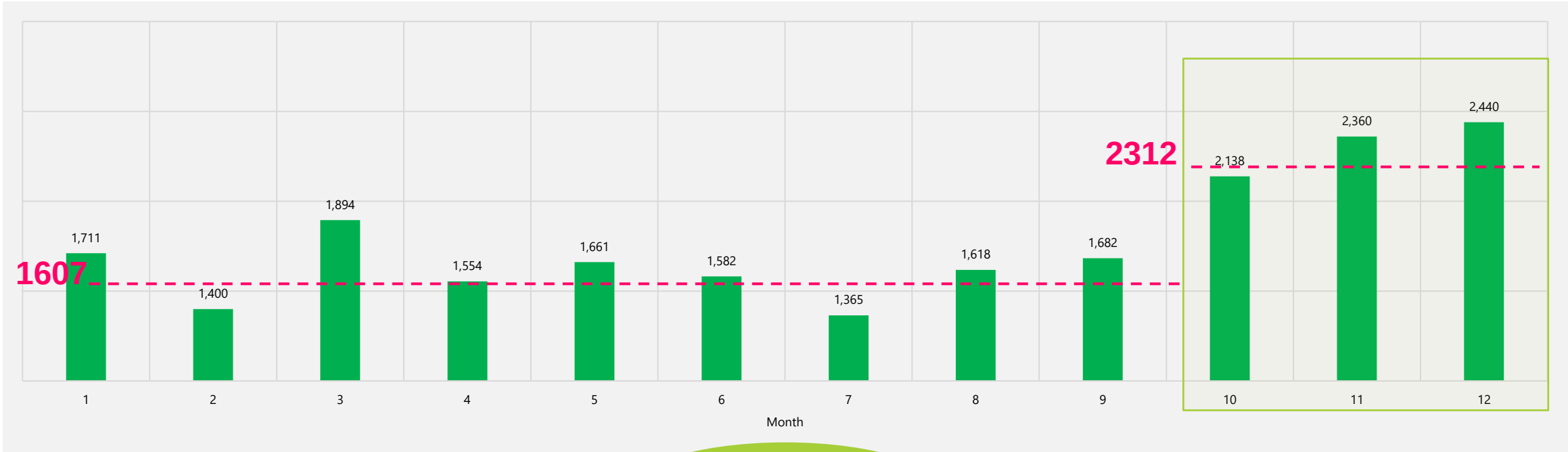
Increase in
production rate



Quality
Improvement

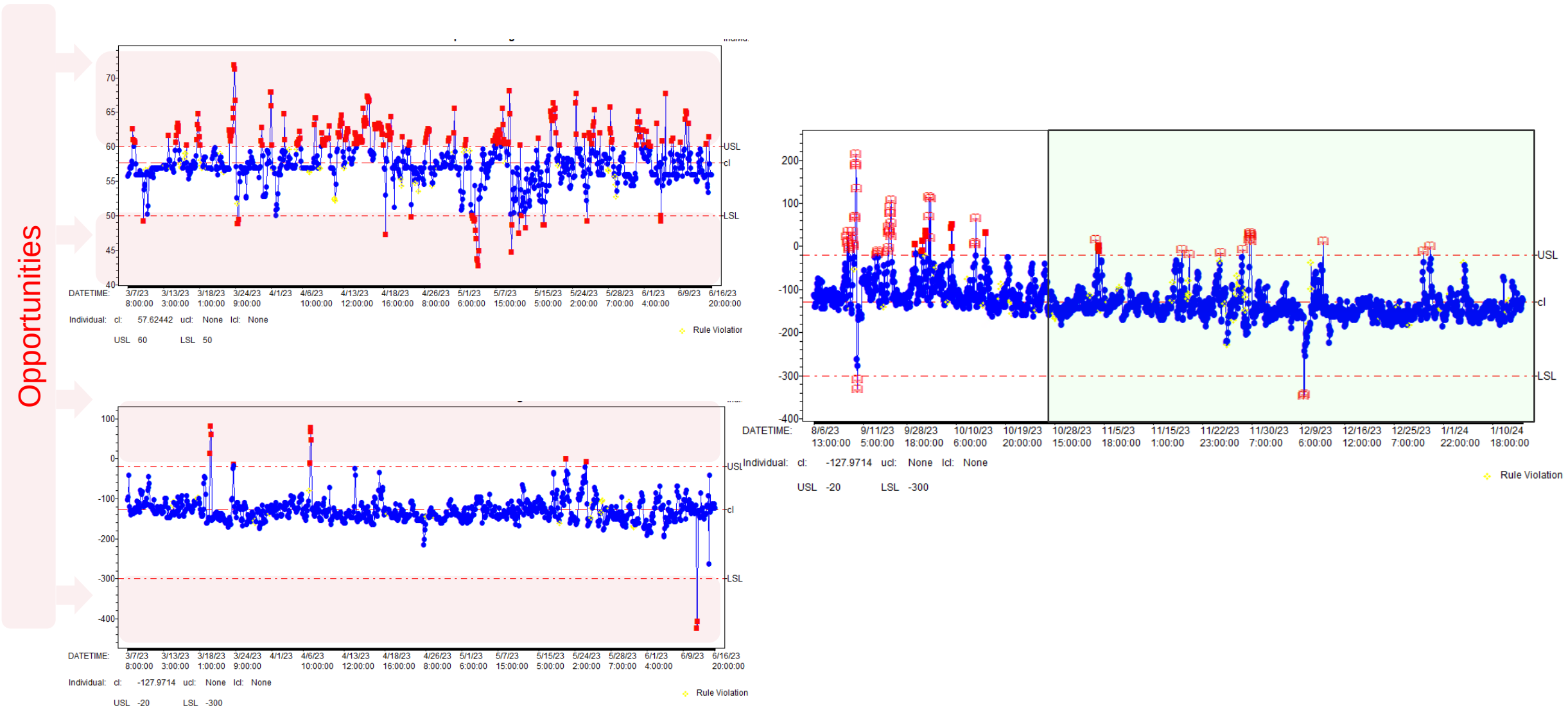


Albemarle Intelligence – Engineer Improvement Project

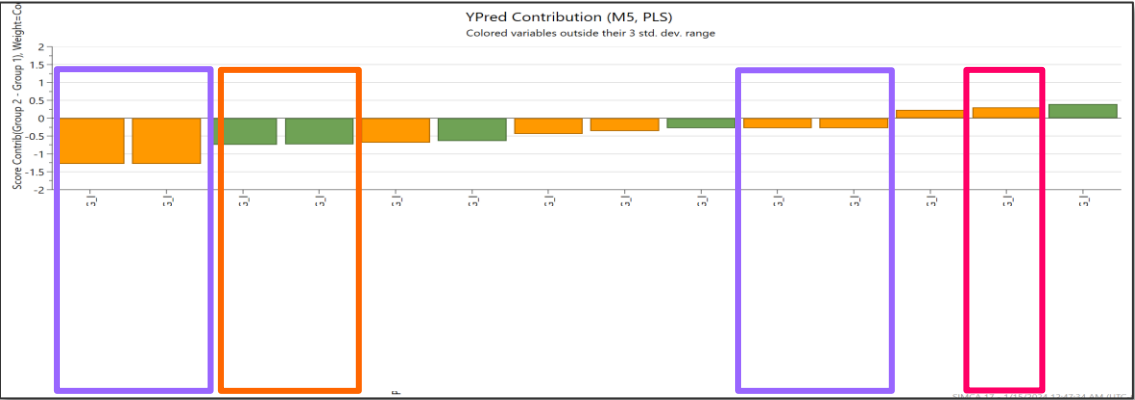
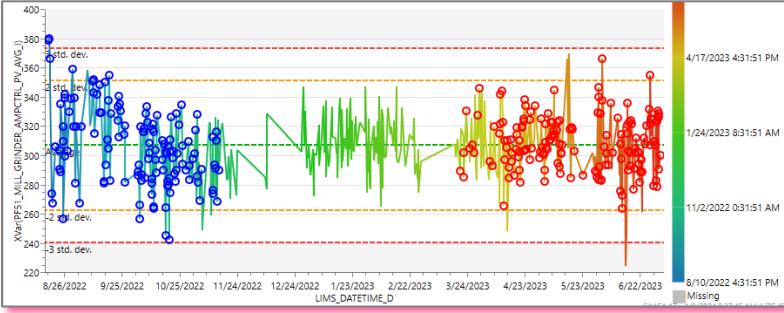
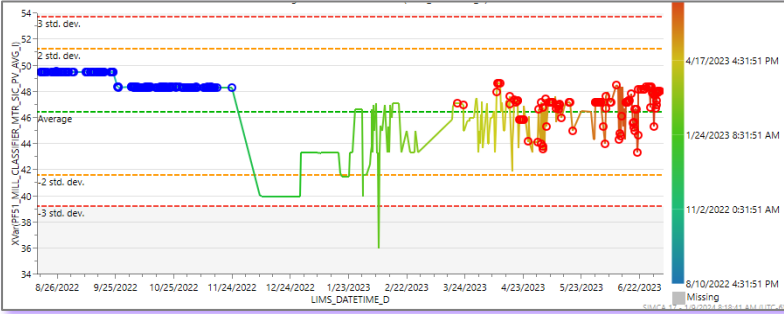
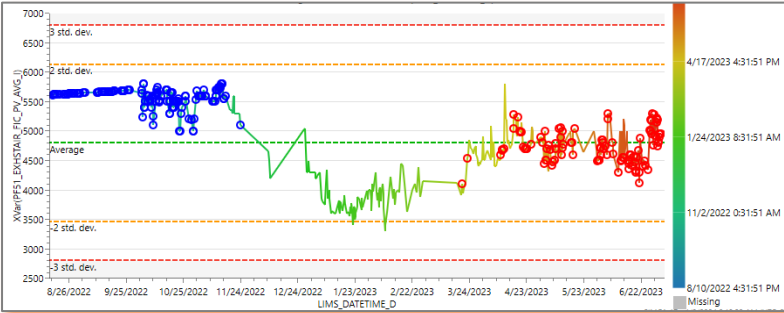
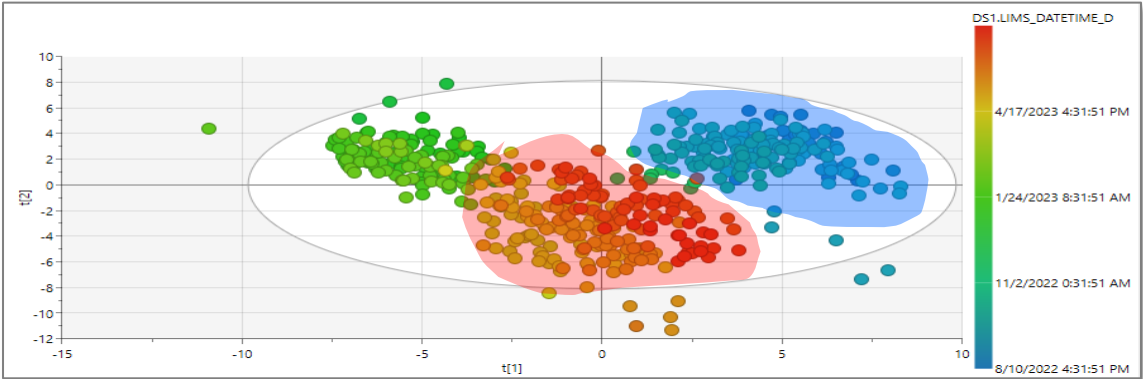


✓ Increase in the monthly production

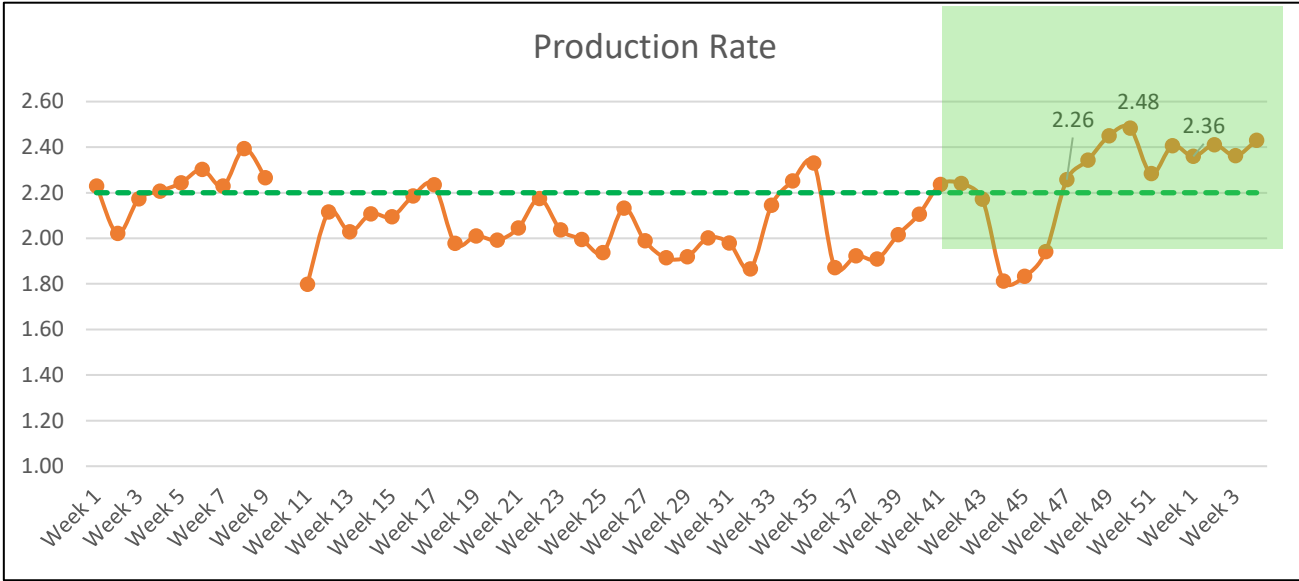
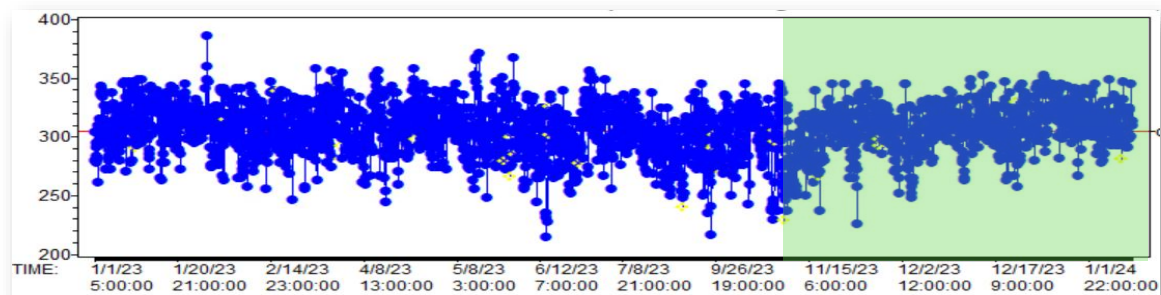
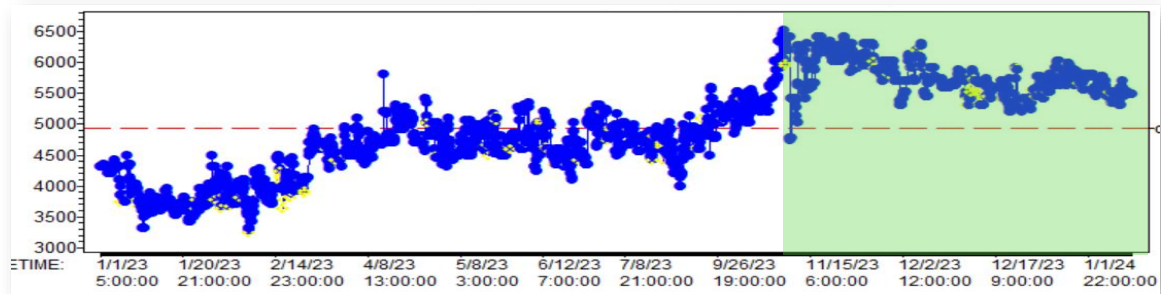
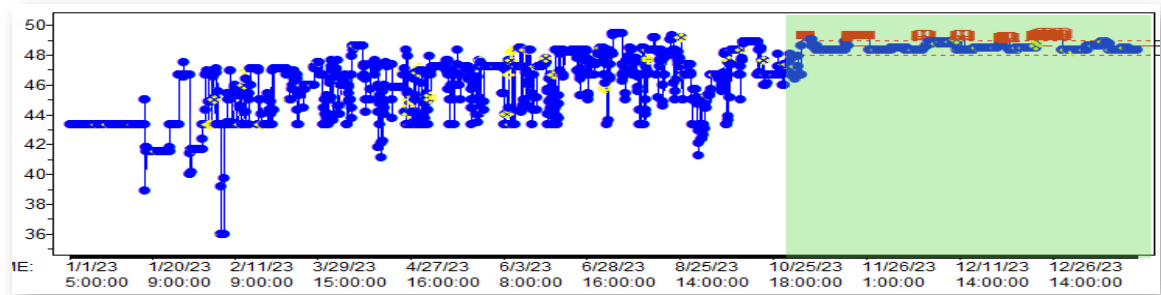
Albemarle Intelligence – Engineer Improvement Project



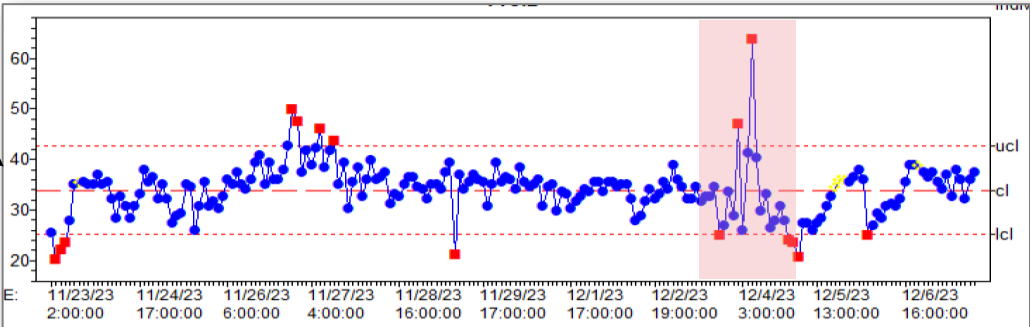
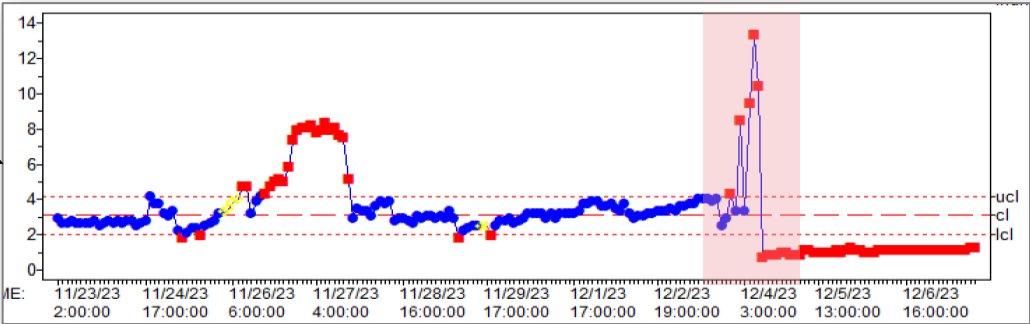
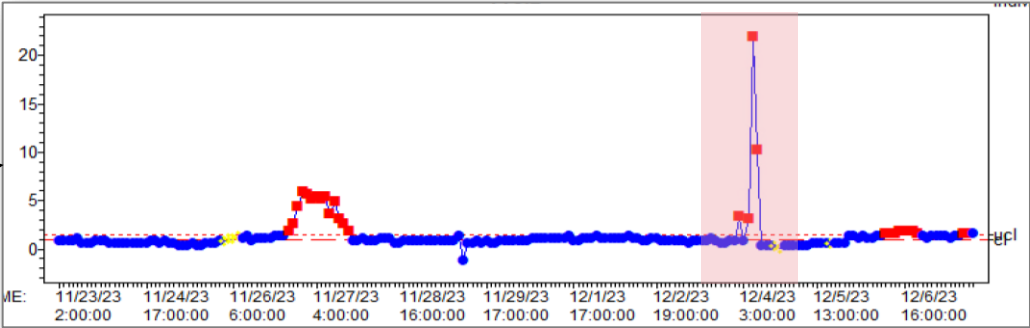
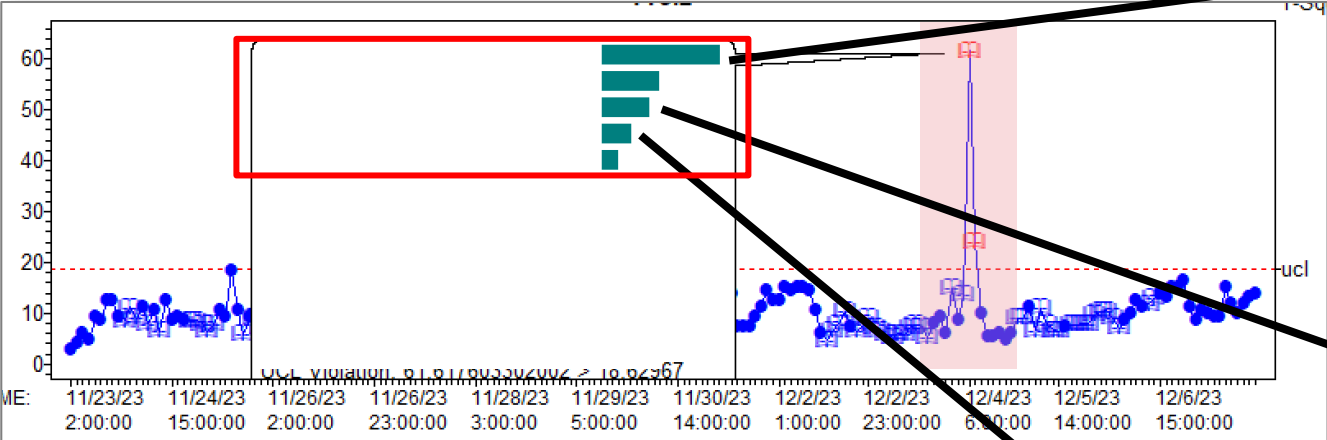
Albemarle Intelligence – Engineer Improvement Project



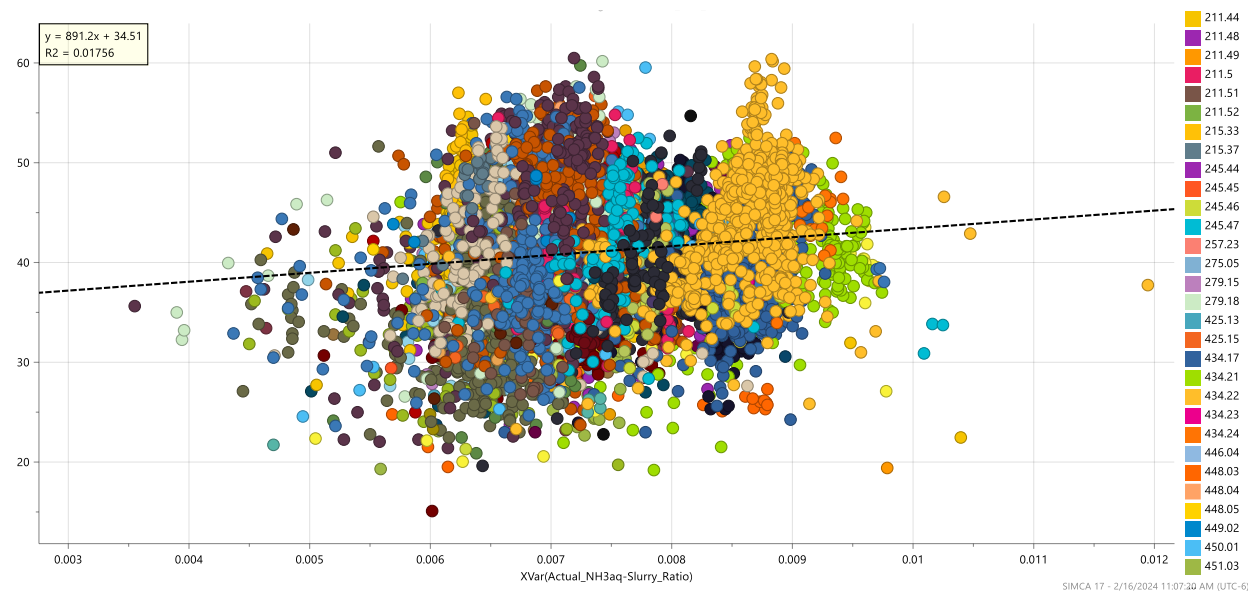
Albemarle Intelligence – Engineer Improvement Project



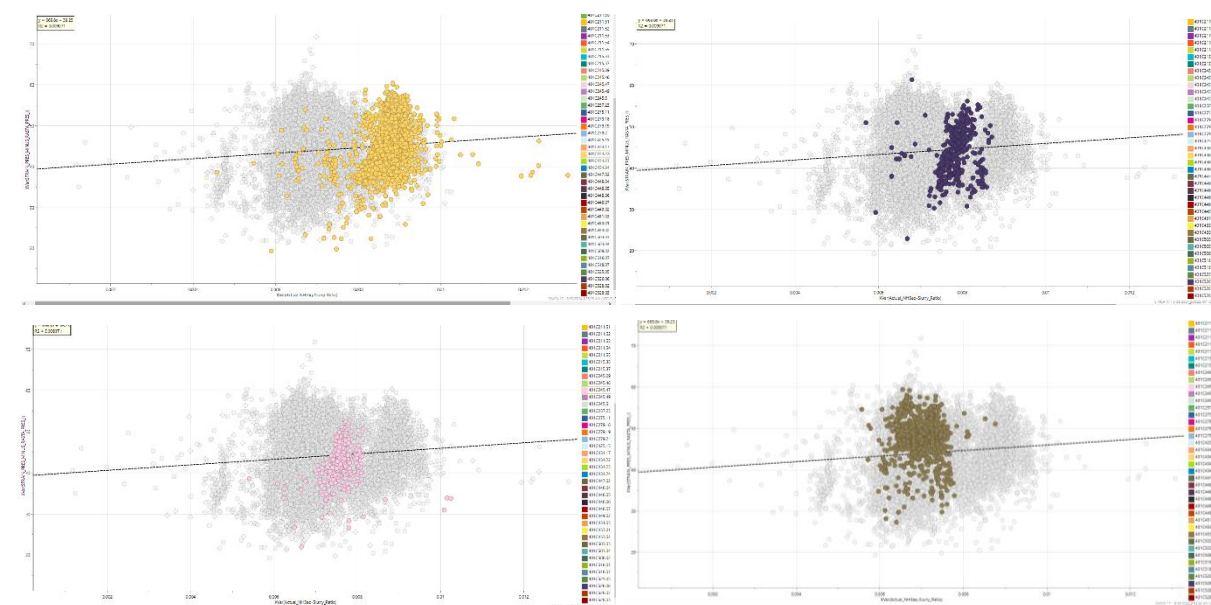
Albemarle Intelligence – Engineer Improvement Project



Albemarle Intelligence – Engineer Improvement Project



SIMCA 17 - 2/16/2024 11:07:20 AM (UTC-6)



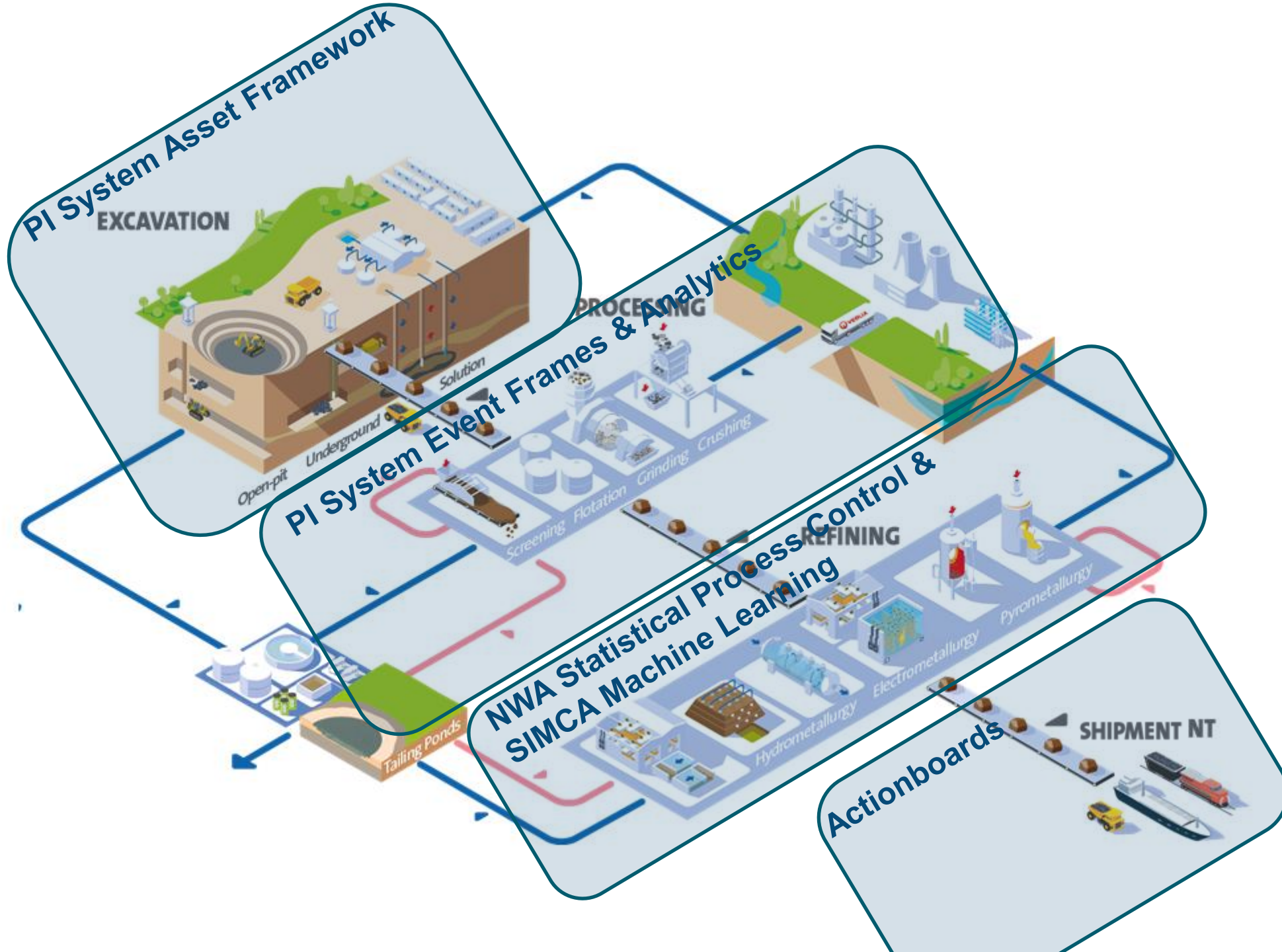
Reason #6

The background is a complex 3D digital composition. A large, central cube is constructed from many smaller, metallic-looking cubes. This central structure is surrounded by a vast field of smaller, individual cubes that appear to be floating or falling from above. The scene is filled with a dense spray of tiny, glowing particles, giving it a sense of dynamic movement and high-tech energy. The lighting is dramatic, with a strong orange and red glow on the right side, transitioning into cooler blue and purple tones on the left. The overall effect is one of a fragmented, yet interconnected, digital or technological environment.

Fragmented Technology, Fragmented Results









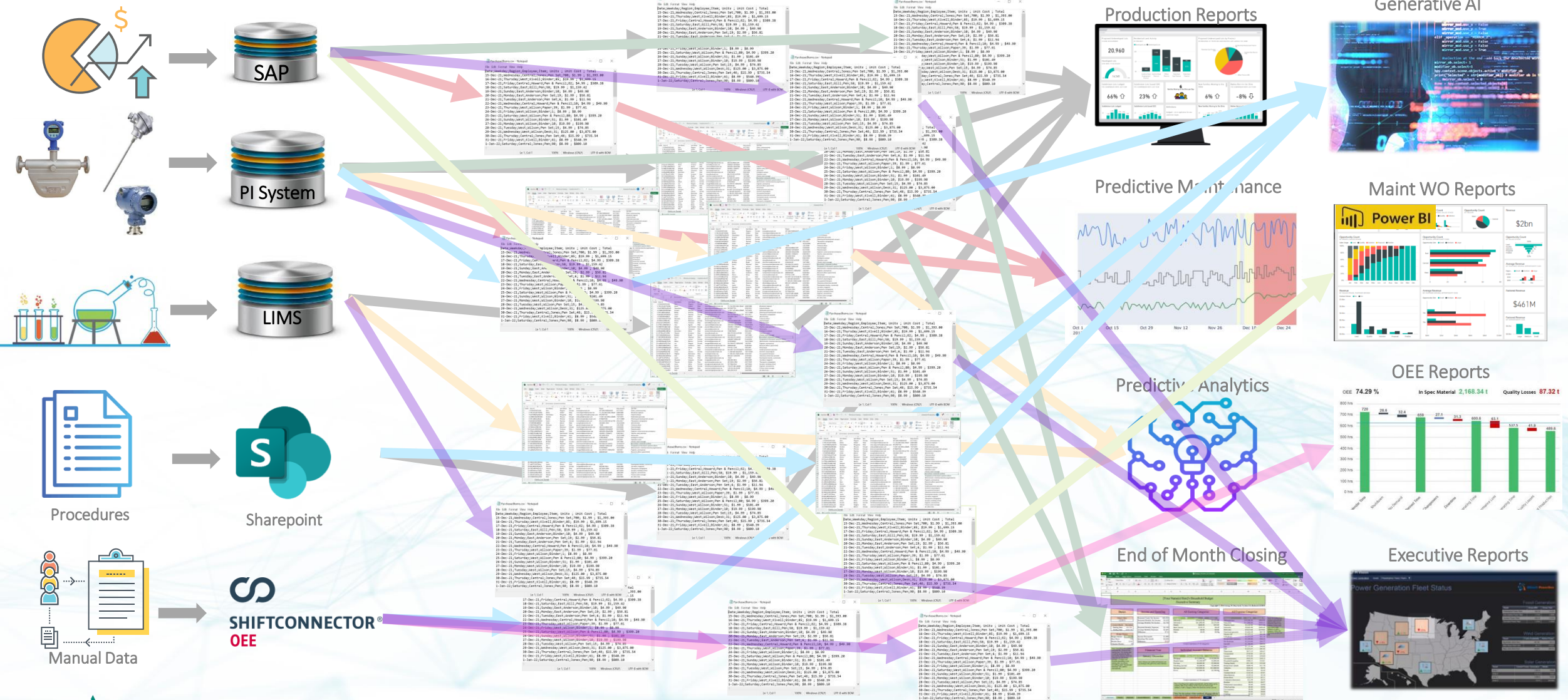


1	12/18/18 10:21:45	13091	1	608	304.1	80.0	2088	44.5	22	104	107	77	104.48	7149	6419.3	2.3	8547.334
2	12/18/18 10:31:45	13092	1	608	303.0	80.2	2048	44.5	23	101	106	77	104.01	7148	6380.0	2.3	8408.183
3	12/20/18 1:30:45	13093	1	607	303.7	81.4	2220	44.5	24	101	105	77	104.13	7149	6385.1	2.3	8479.928
4	12/20/18 7:45:45	13094	1	610	303.7	81.8	2318	44.5	25	98	132	77	104.01	7151	6327.4	2.3	8499.398
5	12/20/18 14:25:45	13095	1	610	-	109.1	2080	44.5	26	98	100	79	102.23	7150	6336.3	2.3	8611.383
6	12/21/18 7:50:45	13096	1	608	304.6	81.4	1227	45	27	108	143	80	102.42	7149	6447.5	2.3	8883.086
7	12/21/18 14:09:45	13097	1	608	304.9	82.7	2054	45	28	98	140	79	102.27	7151	6362.0	2.3	8832.448
8	12/21/18 20:24:45	13098	1	610	303.9	83.4	2061	45	29	97	144	80	102.08	7150	6405.9	2.2	7730.021
9	12/22/18 2:37:45	13099	1	610	303.2	81.2	-	45	30	97	87	80	102.21	7150	6440.3	2.2	8921.211
10	12/22/18 8:33:45	13100	1	611	303.7	80.9	2013	45	31	97	117	78	102.12	7150	6329.9	2.3	8285.421
11	12/23/18 3:43:45	13101	1	609	308.9	79.9	2140	45	32	107	87	80	102.38	7148	6326.2	2.3	7762.863
12	12/23/18 10:00:45	13102	1	608	303.7	80.9	2176	45	33	98	137	81	102.28	7149	6197.6	2.2	8291.748
13	12/23/18 16:50:45	13103	1	611	306.2	85.1	2064	45	34	90	137	82	102.29	7151	6414.4	2.2	7996.285
14	12/23/18 22:04:45	13104	1	-	311.6	81.9	2048	45	35	102	126	74	102.10	7152	6328.4	2.3	10099.03
15	12/24/18 7:31:45	13105	1	602	309.4	81.4	2090	45	36	94	206	71	102.48	7150	6362.3	2.4	11328.12
16	12/24/18 14:37:45	13106	1	646	309.0	84.2	2043	45	37	95	183	74	101.79	7167	6708.0	2.3	11832.73
17	12/24/18 20:33:45	13107	1	603	312.2	85.8	2080	45	38	99	165	79	102.27	7153	6245.2	2.2	9638.7
18	12/25/18 2:45:45	13108	1	603	309.8	82.2	2050	45	39	94	119	70	102.32	7156	6618.0	2.2	11401.3
19	12/25/18 10:40:45	13109	1	603	310.2	81.5	1877	45	40	90	244	72	102.21	7153	6043.8	3.0	11540.20
20	12/26/18 17:28:45	13110	1	602	312.4	85.1	2086	45	41	96	167	77	102.22	7154	6193.3	2.9	10247.01
21	12/26/18 0:00:45	13111	1	609	309.1	84.7	2022	45	42	96	168	80	102.18	7151	6091.4	2.8	8602.66
22	12/26/18 6:03:45	13112	1	609	309.7	83.9	2140	45	43	94	139	72	102.67	7168	6612.0	2.8	11380.13
23	12/26/18 12:05:45	13113	1	603	312.7	83.9	2022	45	44	99	173	79	102.28	7153	6170.2	2.6	9917.619
24	12/26/18 19:22:45	13114	1	605	307.8	85.4	2051	45	45	98	137	81	102.18	7150	6102.3	2.9	7098.47
25	12/27/18 1:54:45	13115	1	608	308.3	84.7	1971	45	46	100	111	81	102.29	7150	6211.3	2.9	7109.498
26	12/27/18 8:48:45	13116	1	606	308.8	83.8	2168	45	47	101	109	80	102.03	7149	6333.1	2.9	8123.948
27	12/27/18 12:44:45	13117	1	609	313.8	84.4	2019	45	48	108	112	80	101.88	7147	6333.8	2.9	8789.883
28	12/27/18 18:03:45	13118	1	603	307.8	84.7	1897	45	49	104	130	78	101.39	7149	6197.0	2.8	8932.823
29	12/28/18 5:09:45	13119	1	602	307.0	85.2	2097	45	50	104	128	79	101.63	7150	6237.0	2.9	9011.07
30	12/28/18 7:06:45	13120	1	602	309.8	85.0	2012	45	51	103	130	78	101.62	7151	6163.3	2.7	8939.528
31	12/28/18 16:17:45	13121	1	698	308.8	85.6	1937	45	52	118	288	85	101.21	7151	6054.8	2.7	8986.975
32	12/28/18 22:40:45	13122	1	697	312.8	85.3	1963	45	53	120	120	86	101.08	7151	6000.9	2.9	10409.81
33	12/28/18 5:20:45	13123	1	690	307.0	85.0	1852	45	54	117	130	83	101.17	7151	6056.3	2.7	9637.63
34	1/11/19 19:03:45	13125	3	695	307.9	85.4	2031	45	55	108	438	56	100.93	7148	6097.0	2.9	10104.2
35	1/12/19 2:10:45	13126	1	699	300.7	87.8	1987	45	57	118	190	86	100.92	7150	6128.3	2.8	7165.784
36	1/12/19 8:16:45	13127	1	677	305.3	85.4	1968	45	58	117	109	84	100.97	7151	6336.5	2.9	10049.31
37	1/12/19 16:02:45	13128	1	602	303.1	83.5	1944	45	59	117	182	82	100.98	7148	6277.2	2.8	8881.688
38	1/12/19 21:23:45	13129	1	602	306.0	84.0	1797	45	60	118	126	80	100.93	7148	6433.7	2.9	9841.389
39	1/13/19 4:11:45	13130	1	605	302.9	82.6	1735	45	61	119	166	83	100.85	7144	6263.0	2.9	8948.879
40	1/13/19 10:39:45	13131	1	602	303.4	83.5	2096	45	62	118	132	83	100.97	7147	6332.8	2.7	9694.894
41	1/13/19 17:18:45	13132	1	603	302.9	82.6	1946	45	63	116	124	80	100.97	7147	6046.4	2.9	9181.318
42	1/13/19 23:45:45	13133	1	602	304.9	83.1	2076	45	64	119	122	81	100.89	7145	6235.0	2.9	9788.119
43	1/14/19 2:23:45	13134	1	602	303.3	83.6	2041	45	65	117	140	80	100.89	7147	6148.1	2.9	9389.709
44	1/14/19 12:00:45	13135	1	602	303.7	83.9	2025	45	66	117	136	81	101.01	7147	6171.1	2.9	9540.422
45	1/14/19 19:23:45	13136	1	602	304.3	83.9	2013	45	67	118	135	82	101.83	7147	6187.4	3.0	9524.005
46	1/15/19 1:47:45	13137	1	602	300.9	83.0	2004	45	68	120	120	82	101.73	7146	6278.3	2.9	9932.090
47	1/15/19 8:09:45	13138	1	603	309.9	83.7	1977	45	69	121	121	82	101.88	7148	6287.2	2.9	9644.836
48	1/15/19 14:28:45	13139	1	602	312.1	83.6	1960	45	70	119	124	81	101.81	7147	6395.9	2.4	10440.04

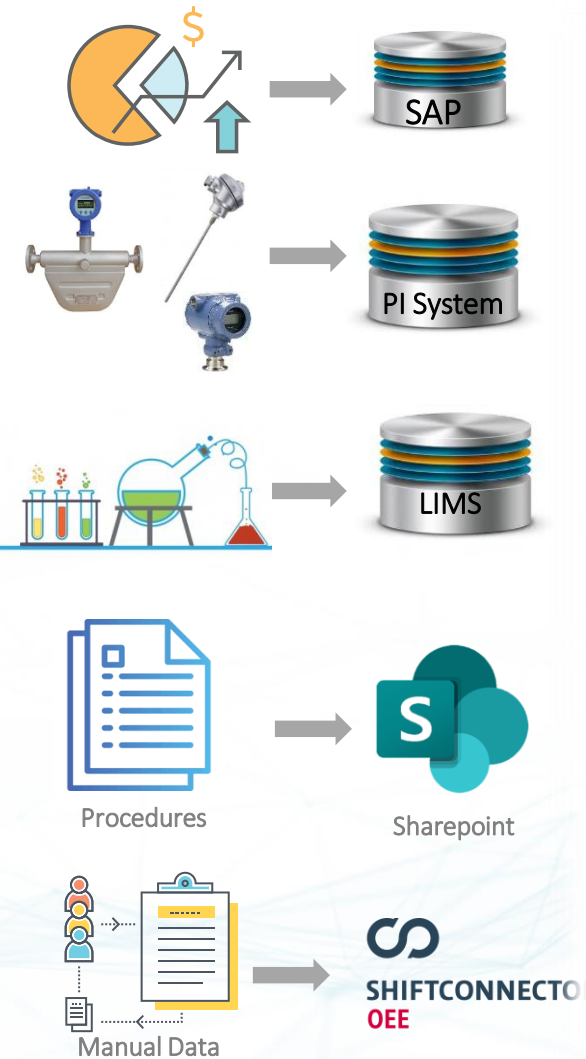
DATA SOURCES

DATA PIPELINES

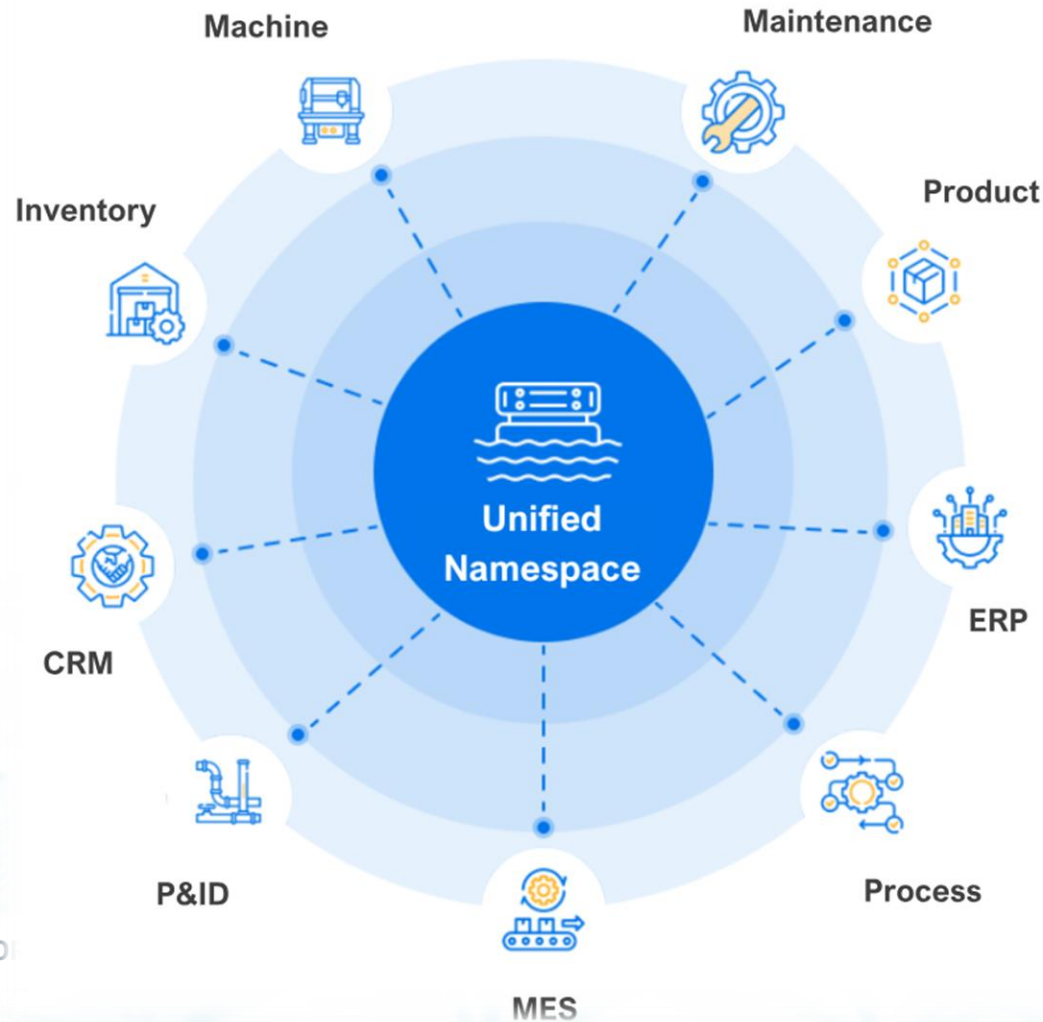
END USERS



DATA SOURCES



DATA PIPELINES



END USERS

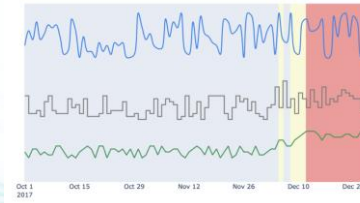
Production Reports



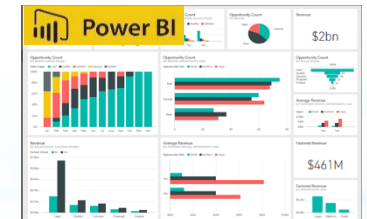
Generative AI



Predictive Maintenance



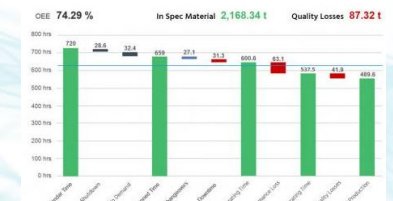
Maint WO Reports



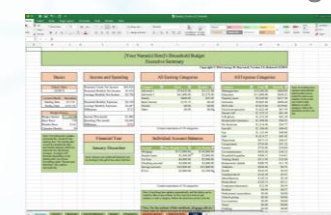
Predictive Analytics



OEE Reports

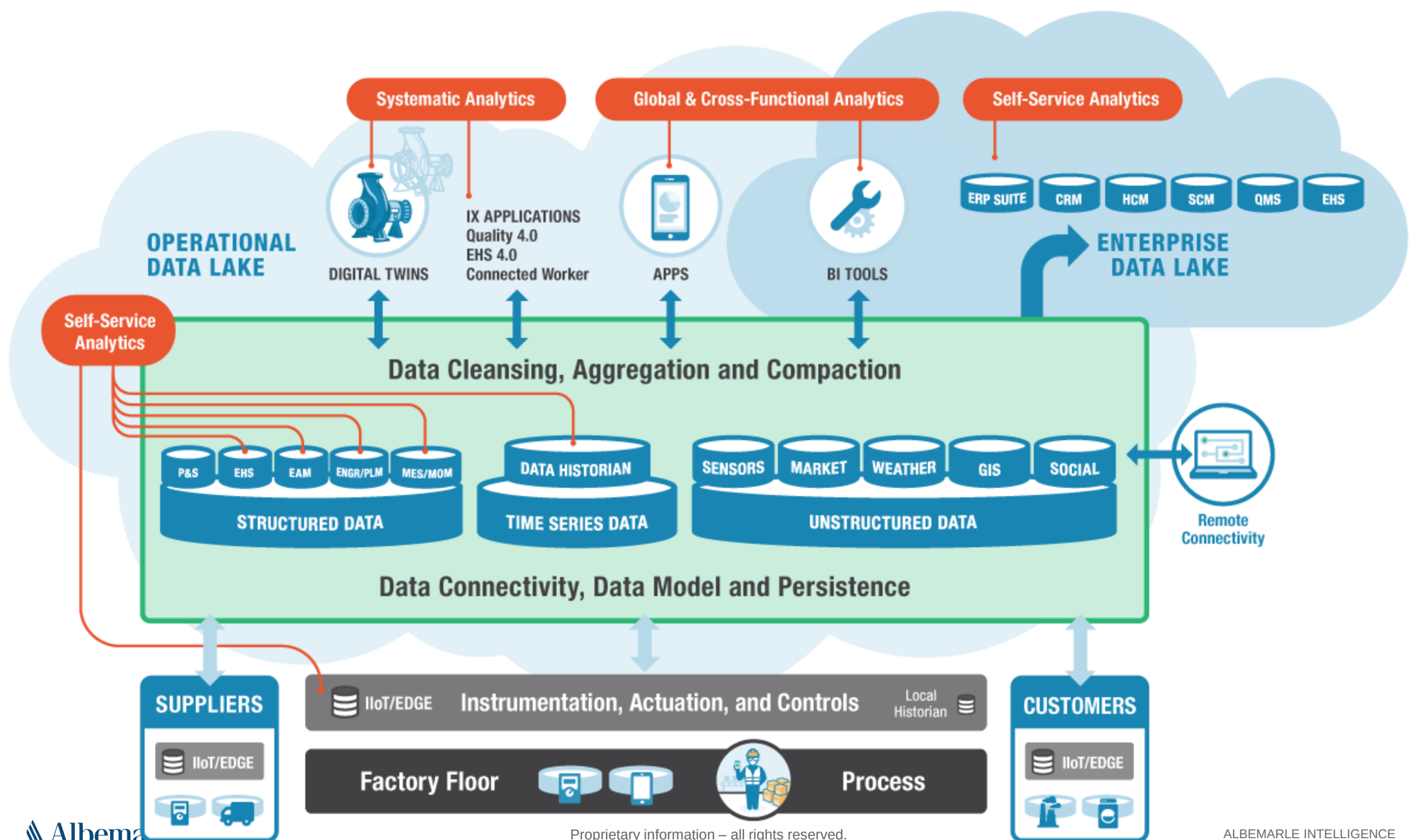


End of Month Closing

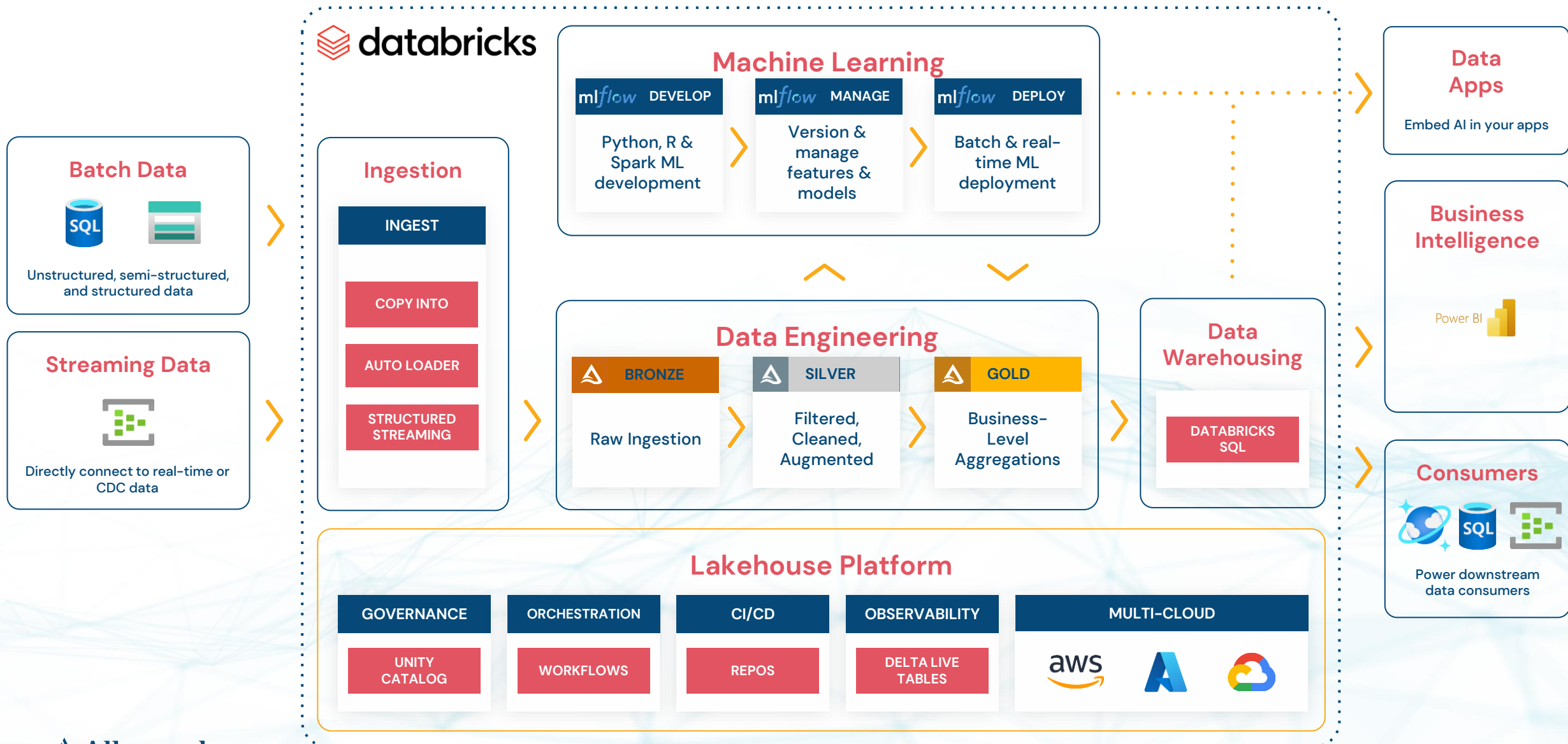


Executive Reports

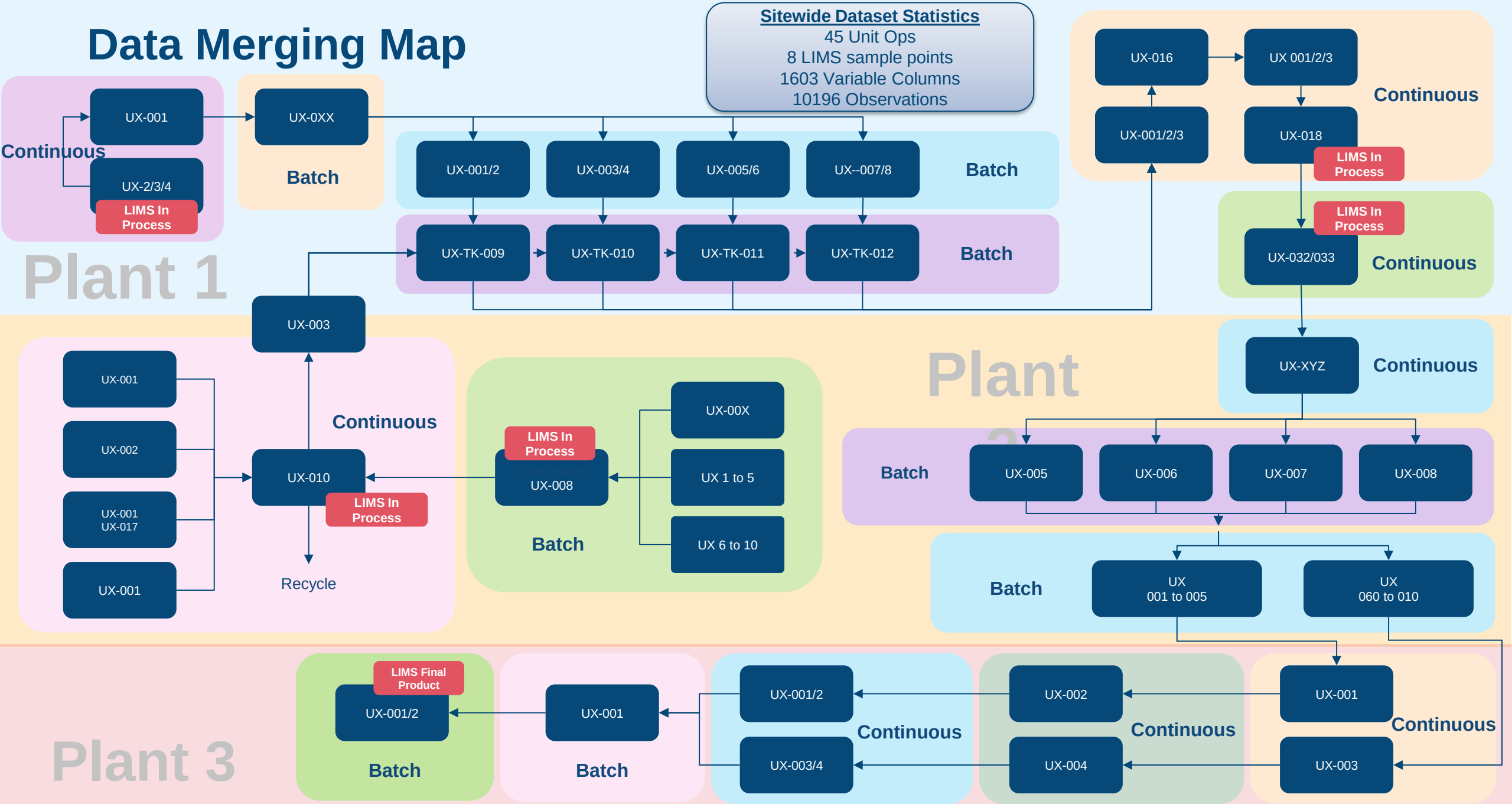




Azure Databricks Lakehouse Architecture



Data Merging Map



Sitewide Data Merging Map

Sitewide Dataset Statistics

45 Unit Ops
8 LIMS sample points
1603 Variable Columns
10196 Observations

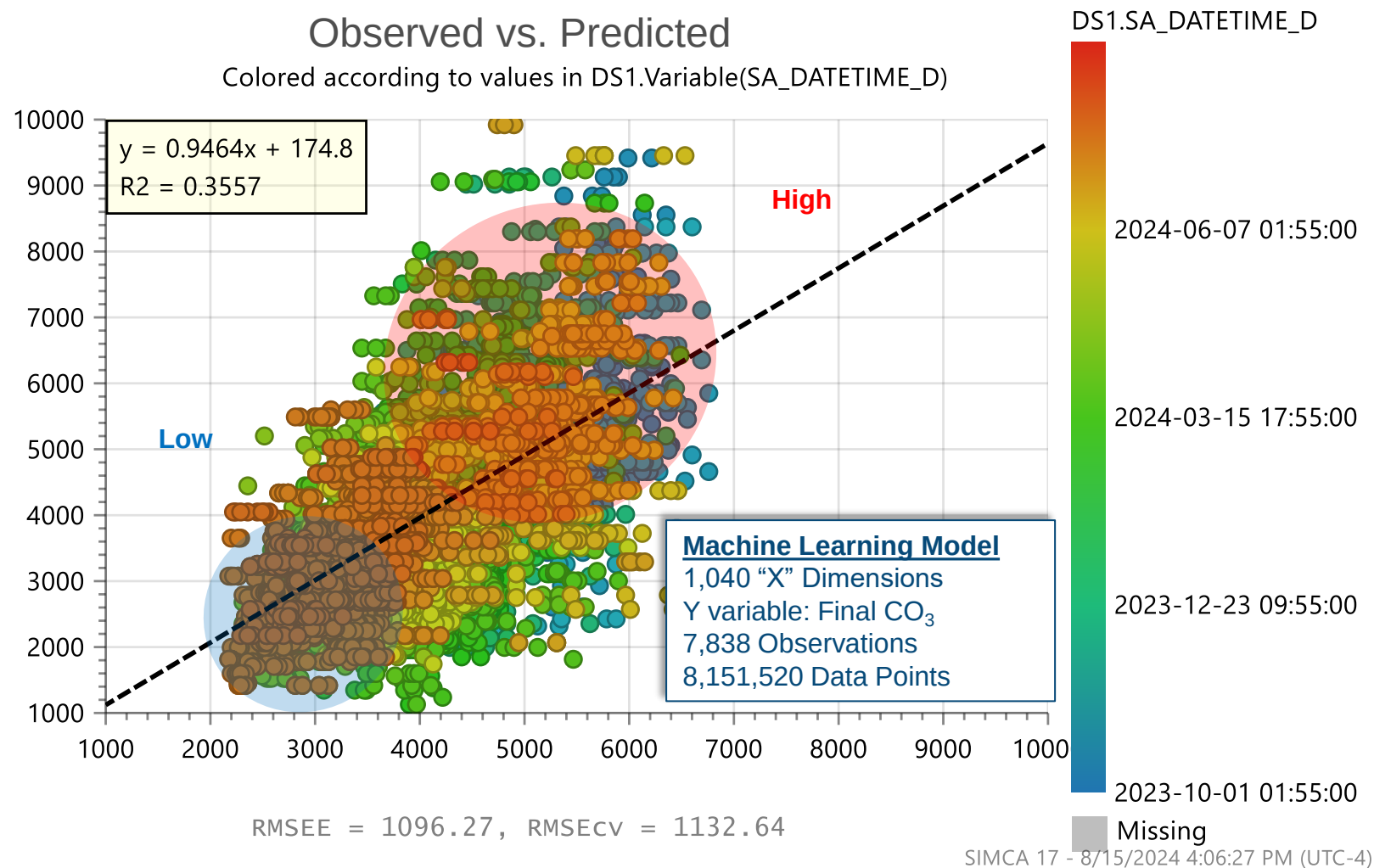
PIAF Dataset

LIMS Dataset

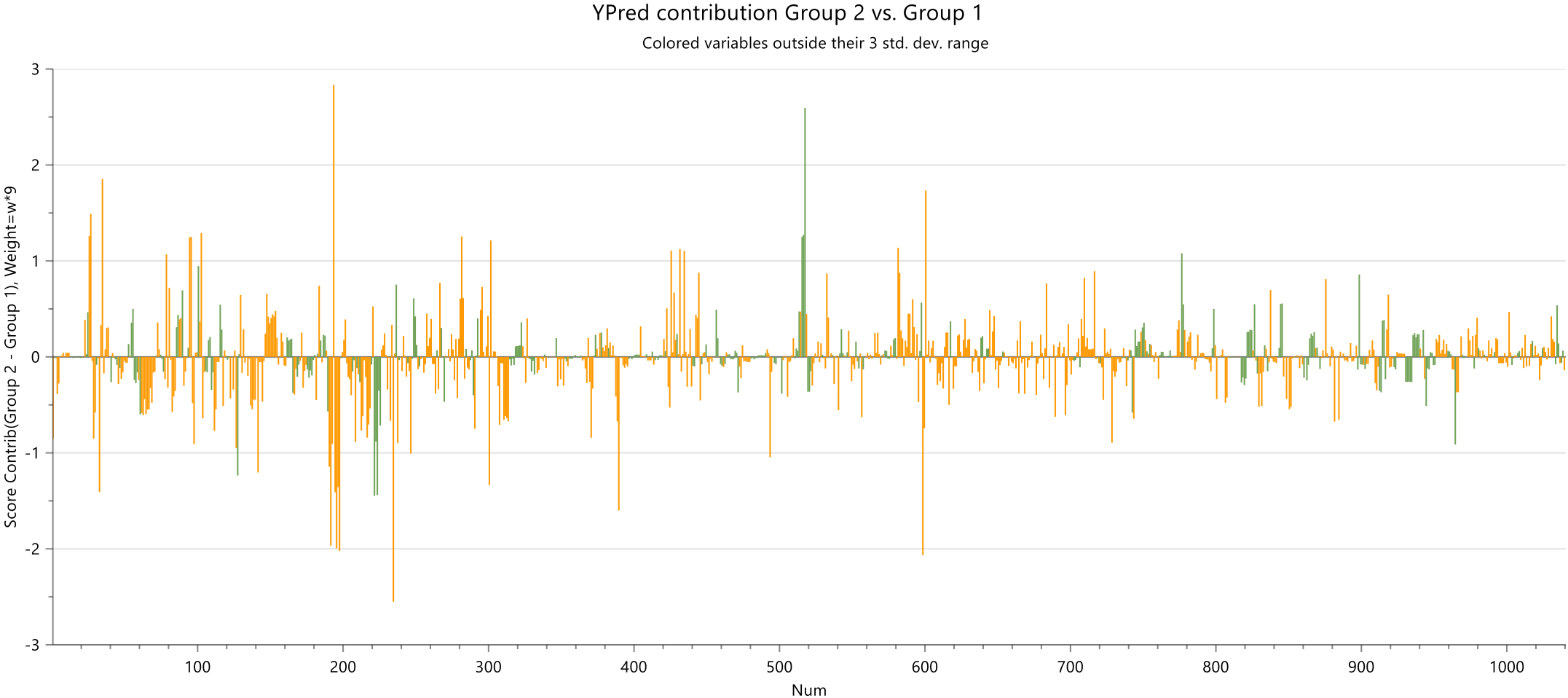
Each row represents the same material passing through the plant as it travels through each unit and sample point.

Cont				Batch				Batch				Batch				Continuous				Cont		Cont		Batch				Batch				Cont		Cont		Batch		Final																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
LIMS In Process				UX-001				UX-001/2				UX-003/4				UX-005/6				UX-007/8				LIMS In Process		UX-TK-009		UX-TK-010				UX-TK-011				UX-TK-012		UX-TK-013				LIMS In Process		UX-005		UX-006				UX-008				UX-009				UX-010		UX-011		UX-012		UX-013		UX-014		UX-015		UX-016		UX-017		UX-018		UX-019		UX-020		UX-021		UX-022		UX-023		UX-024		UX-025		UX-026		UX-027		UX-028		UX-029		UX-030		UX-031		UX-032		UX-033		UX-034		UX-035		UX-036		UX-037		UX-038		UX-039		UX-040		UX-041		UX-042		UX-043		UX-044		UX-045		UX-046		UX-047		UX-048		UX-049		UX-050		UX-051		UX-052		UX-053		UX-054		UX-055		UX-056		UX-057		UX-058		UX-059		UX-060		UX-061		UX-062		UX-063		UX-064		UX-065		UX-066		UX-067		UX-068		UX-069		UX-070		UX-071		UX-072		UX-073		UX-074		UX-075		UX-076		UX-077		UX-078		UX-079		UX-080		UX-081		UX-082		UX-083		UX-084		UX-085		UX-086		UX-087		UX-088		UX-089		UX-090		UX-091		UX-092		UX-093		UX-094		UX-095		UX-096		UX-097		UX-098		UX-099		UX-100		UX-101		UX-102		UX-103		UX-104		UX-105		UX-106		UX-107		UX-108		UX-109		UX-110		UX-111		UX-112		UX-113		UX-114		UX-115		UX-116		UX-117		UX-118		UX-119		UX-120		UX-121		UX-122		UX-123		UX-124		UX-125		UX-126		UX-127		UX-128		UX-129		UX-130		UX-131		UX-132		UX-133		UX-134		UX-135		UX-136		UX-137		UX-138		UX-139		UX-140		UX-141		UX-142		UX-143		UX-144		UX-145		UX-146		UX-147		UX-148		UX-149		UX-150		UX-151		UX-152		UX-153		UX-154		UX-155		UX-156		UX-157		UX-158		UX-159		UX-160		UX-161		UX-162		UX-163		UX-164		UX-165		UX-166		UX-167		UX-168		UX-169		UX-170		UX-171		UX-172		UX-173		UX-174		UX-175		UX-176		UX-177		UX-178		UX-179		UX-180		UX-181		UX-182		UX-183		UX-184		UX-185		UX-186		UX-187		UX-188		UX-189		UX-190		UX-191		UX-192		UX-193		UX-194		UX-195		UX-196		UX-197		UX-198		UX-199		UX-200		UX-201		UX-202		UX-203		UX-204		UX-205		UX-206		UX-207		UX-208		UX-209		UX-210		UX-211		UX-212		UX-213		UX-214		UX-215		UX-216		UX-217		UX-218		UX-219		UX-220		UX-221		UX-222		UX-223		UX-224		UX-225		UX-226		UX-227		UX-228		UX-229		UX-230		UX-231		UX-232		UX-233		UX-234		UX-235		UX-236		UX-237		UX-238		UX-239		UX-240		UX-241		UX-242		UX-243		UX-244		UX-245		UX-246		UX-247		UX-248		UX-249		UX-250		UX-251		UX-252		UX-253		UX-254		UX-255		UX-256		UX-257		UX-258		UX-259		UX-260		UX-261		UX-262		UX-263		UX-264		UX-265		UX-266		UX-267		UX-268		UX-269		UX-270		UX-271		UX-272		UX-273		UX-274		UX-275		UX-276		UX-277		UX-278		UX-279		UX-280		UX-281		UX-282		UX-283		UX-284		UX-285		UX-286		UX-287		UX-288		UX-289		UX-290		UX-291		UX-292		UX-293		UX-294		UX-295		UX-296		UX-297		UX-298		UX-299		UX-300		UX-301		UX-302		UX-303		UX-304		UX-305		UX-306		UX-307		UX-308		UX-309		UX-310		UX-311		UX-312		UX-313		UX-314		UX-315		UX-316		UX-317		UX-318		UX-319		UX-320		UX-321		UX-322		UX-323		UX-324		UX-325		UX-326		UX-327		UX-328		UX-329		UX-330		UX-331		UX-332		UX-333		UX-334		UX-335		UX-336		UX-337		UX-338		UX-339		UX-340		UX-341		UX-342		UX-343		UX-344		UX-345		UX-346		UX-347		UX-348		UX-349		UX-350		UX-351		UX-352		UX-353		UX-354		UX-355		UX-356		UX-357		UX-358		UX-359		UX-360		UX-361		UX-362		UX-363		UX-364		UX-365		UX-366		UX-367		UX-368		UX-369		UX-370		UX-371		UX-372		UX-373		UX-374		UX-375		UX-376		UX-377		UX-378		UX-379		UX-380		UX-381		UX-382		UX-383		UX-384		UX-385		UX-386		UX-387		UX-388		UX-389		UX-390		UX-391		UX-392		UX-393		UX-394		UX-395		UX-396		UX-397		UX-398		UX-399		UX-400		UX-401		UX-402		UX-403		UX-404		UX-405		UX-406		UX-407		UX-408		UX-409		UX-410		UX-411		UX-412		UX-413		UX-414		UX-415		UX-416		UX-417		UX-418		UX-419		UX-420		UX-421		UX-422		UX-423		UX-424		UX-425		UX-426		UX-427		UX-428		UX-429		UX-430		UX-431		UX-432		UX-433		UX-434		UX-435		UX-436		UX-437		UX-438		UX-439		UX-440		UX-441		UX-442		UX-443		UX-444		UX-445		UX-446		UX-447		UX-448		UX-449		UX-450		UX-451		UX-452		UX-453		UX-454		UX-455		UX-456		UX-457		UX-458		UX-459		UX-460		UX-461		UX-462		UX-463		UX-464		UX-465		UX-466		UX-467		UX-468		UX-469		UX-470		UX-471		UX-472		UX-473		UX-474		UX-475		UX-476		UX-477		UX-478		UX-479		UX-480		UX-481		UX-482		UX-483		UX-484		UX-485		UX-486		UX-487		UX-488		UX-489		UX-490		UX-491		UX-492		UX-493		UX-494		UX-495		UX-496		UX-497		UX-498		UX-499		UX-500		UX-501		UX-502		UX-503		UX-504		UX-505		UX-506		UX-507		UX-508		UX-509		UX-510		UX-511		UX-512		UX-513		UX-514		UX-515		UX-516		UX-517		UX-518		UX-519		UX-520		UX-521		UX-522		UX-523		UX-524		UX-525		UX-526		UX-527		UX-528		UX-529		UX-530		UX-531		UX-532		UX-533		UX-534		UX-535		UX-536		UX-537		UX-538		UX-539		UX-540		UX-541		UX-542		UX-543		UX-544		UX-545		UX-546		UX-547		UX-548		UX-549		UX-550		UX-551		UX-552		UX-553		UX-554		UX-555		UX-556		UX-557		UX-558		UX-559		UX-560		UX-561		UX-562		UX-563		UX-564		UX-565		UX-566		UX-567		UX-568		UX-569		UX-570		UX-571		UX-572		UX-573		UX-574		UX-575		UX-576		UX-577		UX-578		UX-579		UX-580		UX-581		UX-582		UX-583		UX-584		UX-585		UX-586		UX-587		UX-588		UX-589		UX-590		UX-591		UX-592		UX-593		UX-594		UX-595		UX-596		UX-597		UX-598		UX-599		UX-600		UX-601		UX-602		UX-603		UX-604		UX-605		UX-606		UX-607		UX-608		UX-609		UX-610		UX-611		UX-612		UX-613		UX-614		UX-615		UX-616		UX-617		UX-618		UX-619		UX-620		UX-621		UX-622		UX-623		UX-624		UX-625		UX-626		UX-627		UX-628		UX-629		UX-630		UX-631		UX-632		UX-633		UX-634		UX-635		UX-636		UX-637		UX-638		UX-639		UX-640		UX-641		UX-642		UX-643		UX-644		UX-645		UX-646		UX-647		UX-648		UX-649		UX-650		UX-651		UX-652		UX-653		UX-654		UX-655		UX-656		UX-657		UX-658		UX-659		UX-660		UX-661		UX-662		UX-663		UX-664		UX-665		UX-666		UX-667		UX-668		UX-669		UX-670		UX-671		UX-672		UX-673		UX-674		UX-675		UX-676		UX-677		UX-678		UX-679		UX-680		UX-681		UX-682		UX-683		UX-684		UX-685		UX-686		UX-687		UX-688		UX-689		UX-690		UX-691		UX-692		UX-693		UX-694		UX-695		UX-696		UX-697		UX-698		UX-699		UX-700		UX-701		UX-702		UX-703		UX-704		UX-705		UX-706		UX-707		UX-708		UX-709		UX-710		UX-711		UX-712		UX-713		UX-714		UX-715		UX-716		UX-717		UX-718		UX-719		UX-720		UX-721		UX-722		UX-723		UX-724		UX-725		UX-726		UX-727		UX-728		UX-729		UX-730		UX-731		UX-732		UX-733		UX-734		UX-735		UX-736		UX-737		UX-738		UX-739		UX-740		UX-741		UX-742		UX-743		UX-744		UX-745		UX-746		UX-747		UX-748		UX-749		UX-750		UX-751		UX-752		UX-753		UX-754		UX-755		UX-756		UX-757		UX-758		UX-759		UX-760		UX-761		UX-762		UX-763		UX-764		UX-765		UX-766		UX-767		UX-768		UX-769		UX-770		UX-771		UX-772		UX-773		UX-774		UX-775		UX-776		UX-777		UX-778		UX-779		UX-780		UX-781		UX-782		UX-783		UX-784		UX-785		UX-786		UX-787		UX-788		UX-789		UX-790		UX-791		UX-792		UX-793	

Machine Learning Predictive Modeling – Quality Parameter 1



Machine Learning Predictive Modeling – Quality Parameter 1



SIMCA 17 - 8/21/2024 3:08:46 PM (UTC-4)

Proprietary information – all rights reserved.

45 Unit Ops

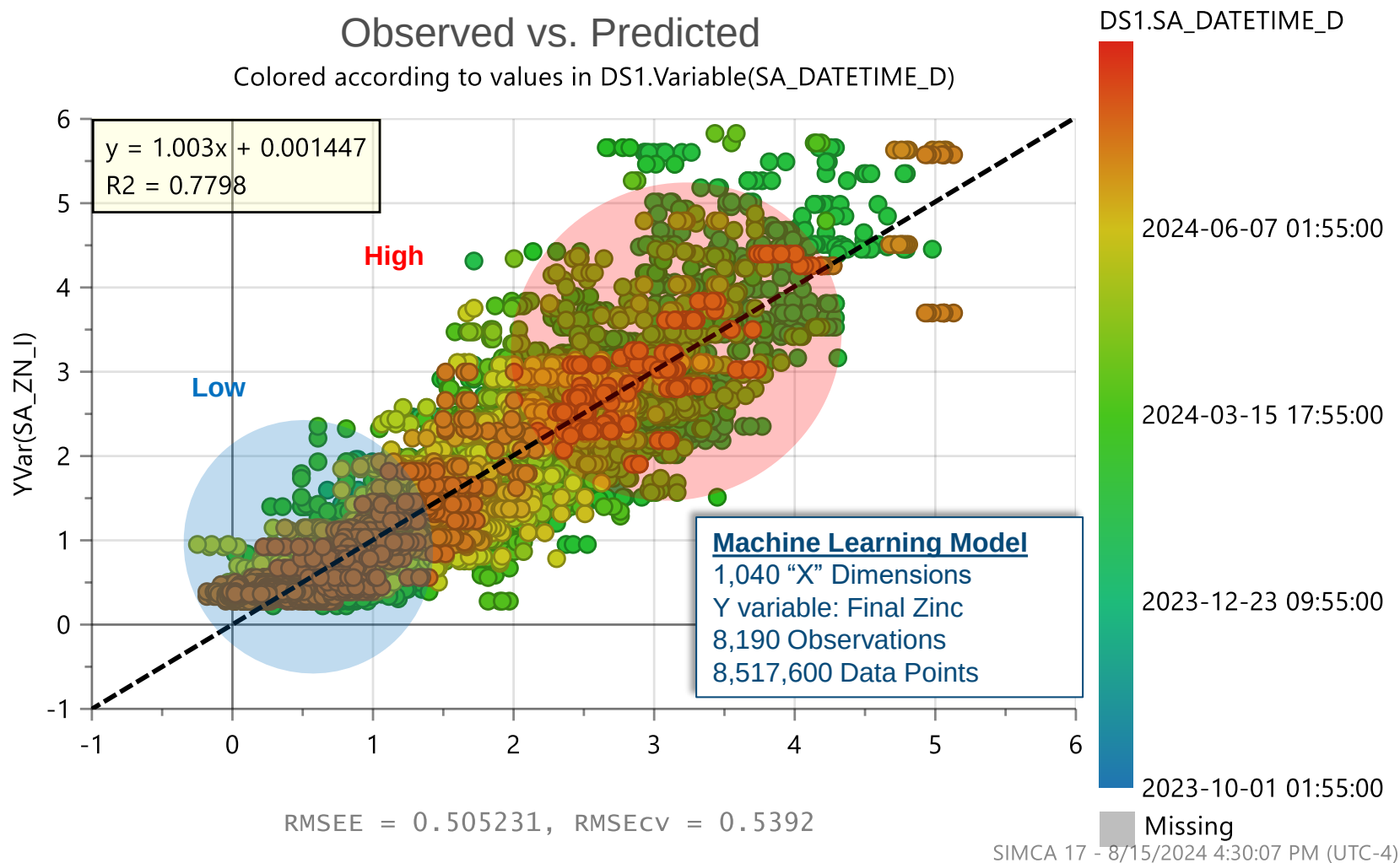
ALBEMARLE INTELLIGENCE

****Above dataset is for demonstration purposes only – complete dataset is too large***

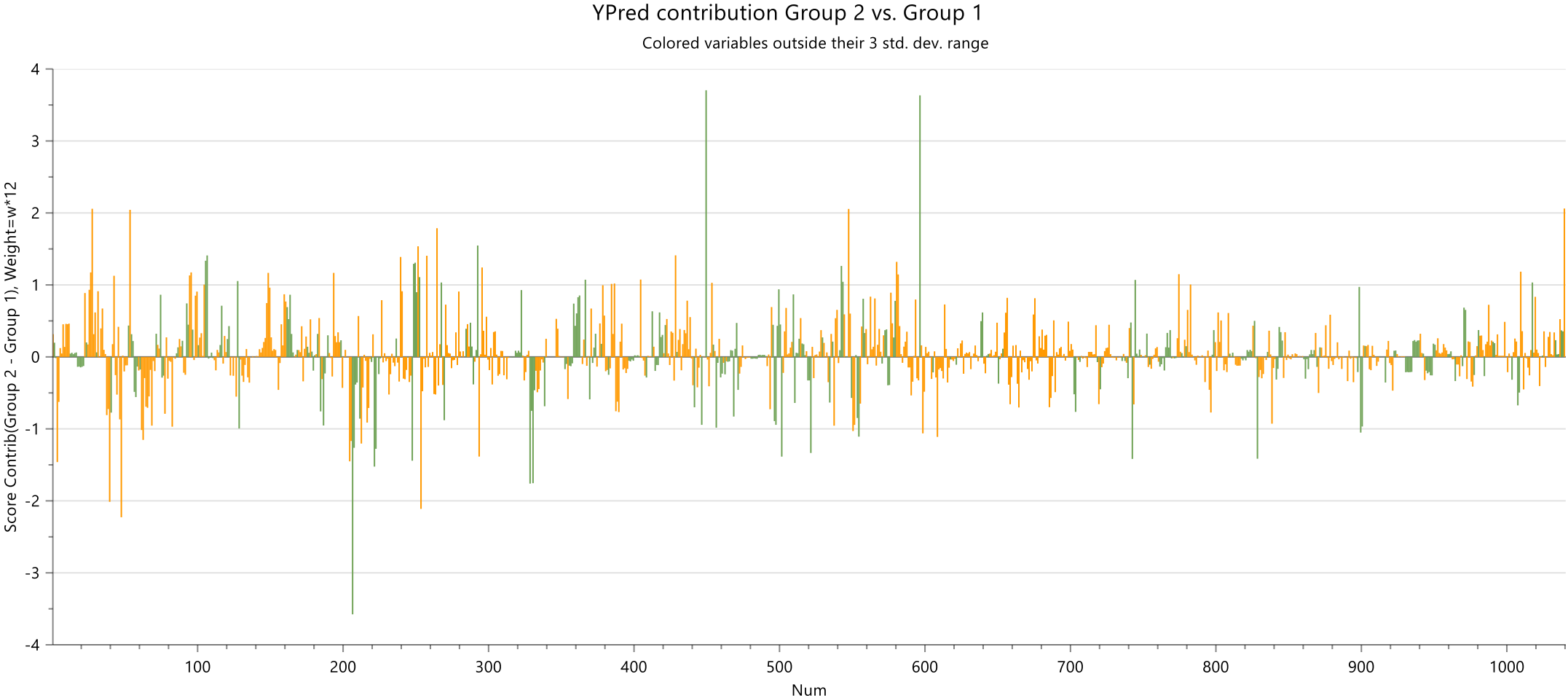
$$Y \text{ Variable} = \text{Final Product Quality}_2$$

	Cont	Batch				Batch				Batch						Continuous		Cont	Cont		Batch			Batch		Cont	Cont		Batch		Cont	Cont	Batch	Final						
LIMS In Process UX-001	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	A	Night	Night	15.3132Z	26.33236	3.563491	449.9914	0.02738	12.3383	0.019759	30	0	0	0	380.1828	19.60374	16.5572	0.204708	0	84.16695	33.95994	20	80	-0.86548	3.310511	0.629352	65.06917	944.0433	56.97776	55.00237	55	-60.626	8.154842	8.1	1370769	15.3132Z	20.96089	36.33
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	A	Night	Night	15.35757	26.3331	3.563491	449.9972	0.028426	13.22919	0.021579	30	0	0	0	389.8162	19.63025	16.5507	0.148008	0	87.27955	33.93856	20	80	-0.87389	3.342463	0.625852	65.9447453	57.01999	54.97903	55	-60.588	8.26442	8.1	136687	15.35757	20.97018	35.96	
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	A	Night	Night	15.34756	26.3919	3.563491	449.9975	0.029194	12.96495	0.020582	30	0	0	0	389.9616	19.57668	16.54757	0.14876	0	83.86269	33.96471	20	80	-0.8823	3.374414	0.629352	65.9458014	57.1229	54.97175	55	-61.261	8.146521	8.1	1366297	15.34756	20.96933	35.8	
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	A	Night	Night	15.3747	26.27371	3.563491	449.9919	0.030034	12.7957	0.016198	30	0	0	0	389.8687	19.20369	16.57133	0.161918	0	83.77966	33.96124	20	80	-0.8907	3.429362	0.771914	67.15107	57.97636	54.30324	55	-60.3322	7.918858	8.1	1372884	15.3747	20.11076	36.47	
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	A	Night	Night	15.68816	26.2398	3.563491	449.9972	0.030928	13.0206	0.01387	30	0	0	0	389.8108	19.06469	16.60032	0.175076	0	79.1151	33.96313	20	80	-0.89911	3.279342	0.795198	65.78514	55.6183	55.04948	55	-59.9491	8.08086	8.1	1371103	15.68816	21.48266	36.2	
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	B	Night	Day	15.68155	26.1049	3.537752	449.9972	0.031822	12.95099	0.010539	30	0	0	0	390.1464	19.22726	16.56965	0.188235	0	80.1464	33.92256	20	80	-0.90752	3.29225	0.795198	65.82833	55.63639	54.96104	55	-59.3186	8.002915	8.1	1369533	15.68155	21.4764	36.22	
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	B	Day	Day	15.68055	26.09939	3.348503	450.0028	0.032716	12.26393	0.007191	30	0	0	0	390.31355	19.49032	16.56333	0.200745	0	84.61786	33.89434	20	80	-0.91593	3.305158	0.795198	65.96111	55.2903	54.95544	55	-59.1681	8.434136	8.1	1371398	15.68055	21.50427	36.27	
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	B	Day	Day	15.58494	26.21661	3.481916	449.9972	0.03361	13.09992	0.003843	30	0	0	0	390.21292	19.06469	16.5588	0.190283	0	81.31333	33.86068	20	80	-0.67788	3.305755	0.788177	69.20116	57.12379	55.34268	55	-59.4941	8.143876	8.1	1378705	15.58494	21.47073	37.00	
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	B	Day	Day	15.58182	26.11684	3.486673	450.0028	0.032258	13.1869	4.96E-04	30	0	0	0	390.7449	19.86466	16.55046	0.194077	0	80.60011	33.86693	20	80	-0.89249	3.502548	0.84023	72.59897	105.3436	56.56184	54.48314	55	-58.9551	8.005714	8.1	1378577	15.58182	21.48074	37.0
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	B	Day	Day	15.6061	26.03729	3.36754	449.9917	0.024186	12.38759	-0.00273	30	0	0	0	391.4444	20.06693	16.53811	0.177477	0	83.38445	33.84698	20	80	-0.96595	3.323272	0.714012	65.11986	94.6259	57.2829	53.76735	55	-58.2597	8.003524	8.1	1375838	15.6061	21.47147	36.82
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	B	Day	Day	15.63345	25.94886	3.36754	449.9972	0.015664	11.62605	-0.00233	30	0	0	0	390.6973	20.20918	16.53391	0.184967	0	83.36877	33.81099	20	80	-0.89746	3.306799	0.650976	65.43639	95.8392	57.58355	55.03463	55	-57.5304	8.263757	8.1	1374522	15.63345	21.48852	36.5
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	B	Day	Day	15.63528	25.85064	3.36754	450	0.007142	10.0398	2.41E-04	30	0	0	0	390.7159	20.25926	16.52978	0.192187	0	80.7346	33.98575	20	80	-0.7346	3.308259	0.75072	67.42555	88.1642	60.22474	54.34275	55	-56.5735	8.106703	8.1	1375917	15.63528	21.51285	36.9
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	B	Day	Day	15.66636	25.55799	3.36754	450	-0.00138	10.04478	0.001846	30	0	0	0	391.4399	20.45793	16.55571	0.199407	0	85.5007	33.82386	20	80	-0.75402	3.293761	0.721994	65.39333	94.82256	57.37094	55.02362	55	-55.4599	7.997003	8.1	1371663	15.66636	21.48897	36.3
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	B	Day	Day	15.67754	25.59921	3.36754	450	-0.0099	9.94533	0.003932	30	0	0	0	390.9588	20.70588	16.57905	0.199979	0	84.15601	33.84589	20	80	-0.60649	3.308011	0.721994	65.50027	94.678	57.45025	54.96796	55	-56.0954	8.071118	8.1	1371373	15.67754	21.49976	36.38
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	B	Day	Day	15.65481	25.52224	3.31664	449.9969	-0.01842	8.869372	0.006108	30	0	0	0	391.4576	19.27963	16.60222	0.174968	0	77.95671	33.80914	20	80	-0.71367	3.32261	0.721994	65.45556	95.2922	57.51808	54.98381	55	-60.0443	8.033635	8.1	1372383	15.65481	21.4844	36.4
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	B	Day	Day	15.60858	25.49652	3.374679	450	0.02694	10.30801	0.008104	30	0	0	0	390.9542	19.29473	16.58413	0.170059	0	87.37888	33.80914	20	80	-0.83811	3.415005	0.767931	67.37458	97.8419	59.9372	54.31979	55	-56.2452	8.034025	8.1	1377717	15.60858	21.50421	36.92
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	B	Day	Day	15.58672	25.66354	3.374679	449.9972	0.02971	11.33176	0.01019	30	0	0	0	390.1195	19.26339	16.54871	0.169701	0	89.05133	33.7731	20	80	-0.99769	3.317314	0.733159	64.49417	936.2744	56.32693	54.87979	55	-57.0066	8.055152	8.1	1379817	15.58672	21.50682	37.11
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	A	Day	Night	15.57915	25.8094	3.374679	450.0028	0.02272	11.42206	0.012343	30	0	0	0	390.0054	18.9103	16.50263	0.169344	0	80.24329	33.76944	20	80	-0.87678	3.361603	0.733159	64.94695	941.2297	56.71533	54.97216	55	-57.9649	8.113949	8.1	1379326	15.57915	21.49873	37.11
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	A	Night	Night	15.58137	25.82887	3.374679	450	0.01557	11.42272	0.01311	30	0	0	0	389.967	18.34214	16.51355	0.176602	0	89.51714	33.77739	20	80	-0.65805	3.41468	0.76305	67.32736	98.6625	60.01838	54.35681	55	-57.8932	8.334682	8.1	1380671	15.58137	21.51275	37.3
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	A	Night	Night	15.49747	25.82562	3.374679	450	0.00841	11.52561	0.013938	30	0	0	0	390.0137	20.01013	16.55567	0.151764	0	79.65741	33.78959	20	80	-0.67971	3.292489	0.69215	65.43847	94.8517	57.39392	55.02759	55	-57.6192	8.621061	8.1	1387322	15.49747	21.49998	37.2
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	A	Night	Night	15.43973	25.82022	3.374679	449.9972	0.00126	10.56877	0.014527	30	0	0	0	390.1097	21.11463	16.57926	0.175384	0	84.04668	33.80082	20	80	-0.72566	3.32403	0.69215	65.94139	939.3481	56.58429	54.96791	55	-57.6876	8.356791	8.1	1393285	15.43973	21.51194	38.3
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	A	Night	Night	15.44213	25.78129	3.374679	450	0.005892	10.32316	0.015367	30	0	0	0	390.2532	21.04641	16.60722	0.182402	0	79.43617	33.76638	20	80	-0.77133	3.371958	0.69215	64.98889	939.7933	56.58582	54.96677	55	-57.2437	8.345386	8.1	1391427	15.44213	21.4866	38.3
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	A	Night	Night	15.40347	25.69442	3.320505	450	0.013405	11.33952	0.015744	30	0	0	0	390.3263	21.00373	16.56485	0.186165	0	87.27774	33.612	20	80	-0.80109	3.383254	0.721857	66.36819	956.9255	59.04988	53.88374	55	-56.7894	8.417252	8.1	1394228	15.40347	21.47595	38.40
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	A	Night	Night	15.45533	25.7242	3.461726	449.9939	0.024724	12.36951	0.016592	30	0	0	0	391.6885	21.14992	16.54024	0.184685	0	83.61339	33.66485	20	80	-0.83623	3.347405	0.678802	64.07291	933.4739	55.05781	54.95889	55	-56.6942	8.182807	8.1	1393933	15.45533	21.49733	38.5
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	A	Night	Night	15.46966	25.60073	3.39196	450	0.024795	12.01162	0.017483	30	0	0	0	391.8495	21.4141	16.55479	0.210184	0	78.5097	33.70346	20	80	-0.78542	3.415358	0.724005	64.77861	971.482	58.41199	54.9	55	-55.8243	8.23912	8.1	1389842	15.46966	21.48646	38.6
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	A	Night	Night	15.43518	25.52571	3.257574	449.9972	0.016694	10.6263	0.018073	30	0	0	0	391.4514	21.57655	16.54944	0.206703	0	83.76697	33.76129	20	80	-0.71684	3.621445	0.679901	63.11667	934.480	57.17947	54.911	55	-55.2804	8.238652	8.1	1391905	15.43518	21.4843	38.6
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	A	Night	Night	15.7293	25.60	3.257574	449.9972	0.014072	10.53153	0.01809	30	0	0	0	391.0414	21.7079	16.5499	0.14372	0	84.15848	33.6599	20	80	-0.86325	3.270418	0.679901	65.42514	934.468	56.14044	54.9	55	-55.5659	8.279861	8.1	1397793	15.7293	21.50335	38.8
	00.00.00	Belt Filter 06. Belt Filter 2181 FIA	A	Night	Night	15.4441	25.444	3.257574	449.9972	0.014944	10.29013	0.017436	30	0	0	0	390.7579	21.7879	16.5414	0.167436	0	84.88625	33.6848	20	80	-0.75799	3.278	0.679901	65.96474	926.0472	54.915	55	-56.6309	8.1301	8.1	139459	15.4441	21.49178		

Machine Learning Predictive Modeling – Quality Parameter 2



Machine Learning Predictive Modeling – Final Prod Zinc



Modern Machine Learning for Time Series – XGBoost



Feature Importance (Python)

Import Notebook

1

```
from pyspark.sql import SparkSession
from pyspark.sql.functions import col
from pyspark.sql.types import NumericType
import pandas as pd
import numpy as np
!pip install networkx
import networkx as nx
import warnings
warnings.filterwarnings("ignore")
%pip install xgboost
from sklearn.ensemble import IsolationForest
from sklearn.impute import SimpleImputer
import xgboost as xgb
from sklearn.model_selection import train_test_split, cross_val_score, KFold
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import make_scorer, mean_squared_error
from sklearn.preprocessing import MinMaxScaler
from sklearn.preprocessing import RobustScaler

# Drop rows with NaN values in the target column from the original dataframe before splitting
df_filtered_zn_clean = df_filtered_zn.dropna(subset=[target_column])

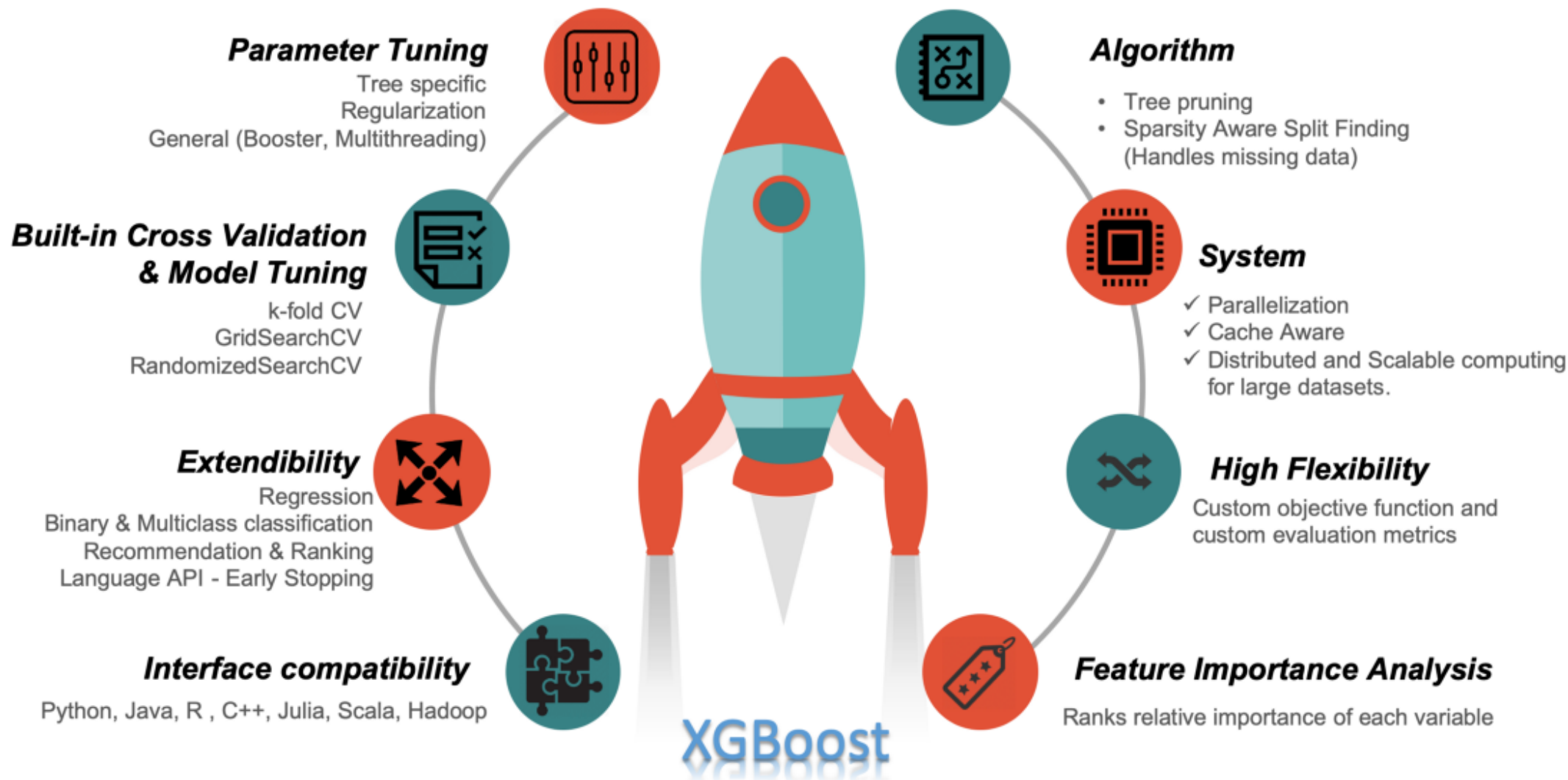
X = df_filtered_zn_clean.drop(target_column, axis=1)
y = df_filtered_zn_clean[target_column]

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

xgb_model = xgb.XGBRegressor(missing=None, random_state=42)
kf = KFold(n_splits=5, shuffle=True, random_state=42)
mse_scorer = make_scorer(mean_squared_error, greater_is_better=False)
cv_scores = cross_val_score(xgb_model, X_train, y_train, cv=kf, scoring=mse_scorer)

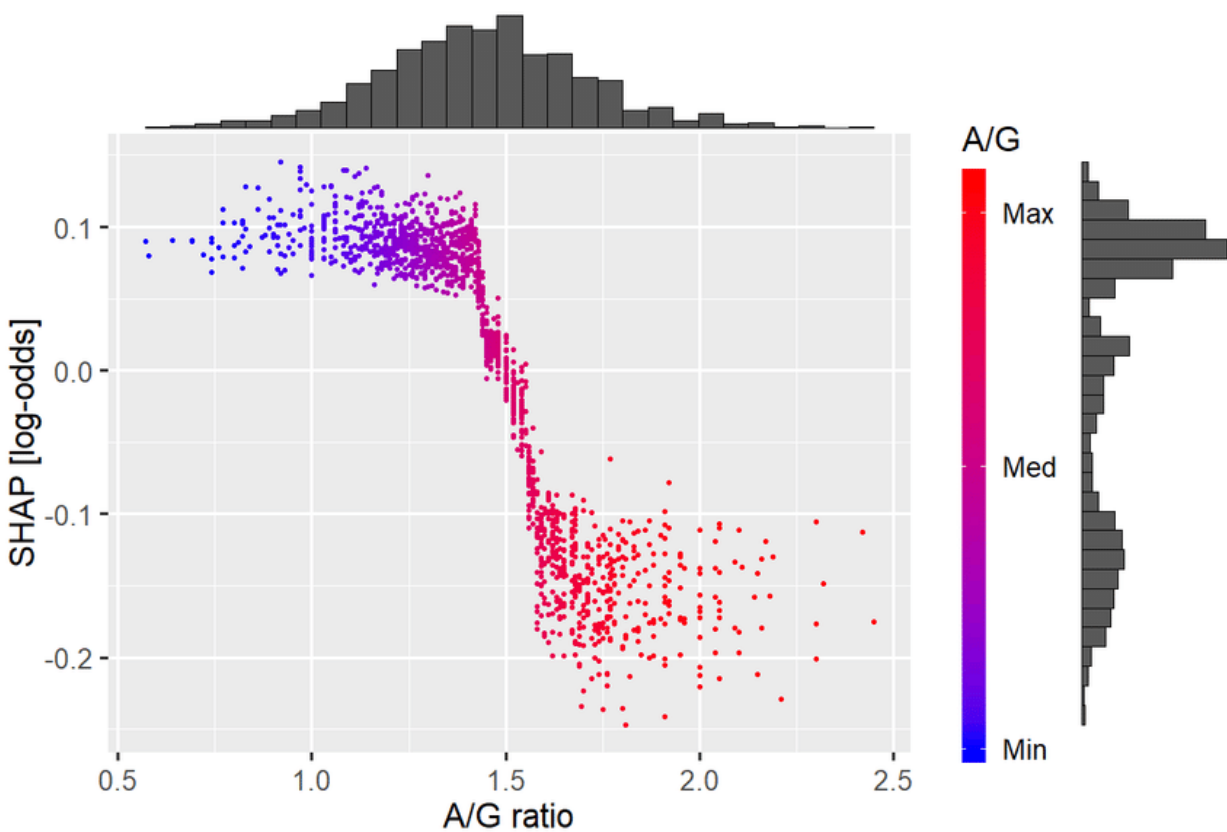
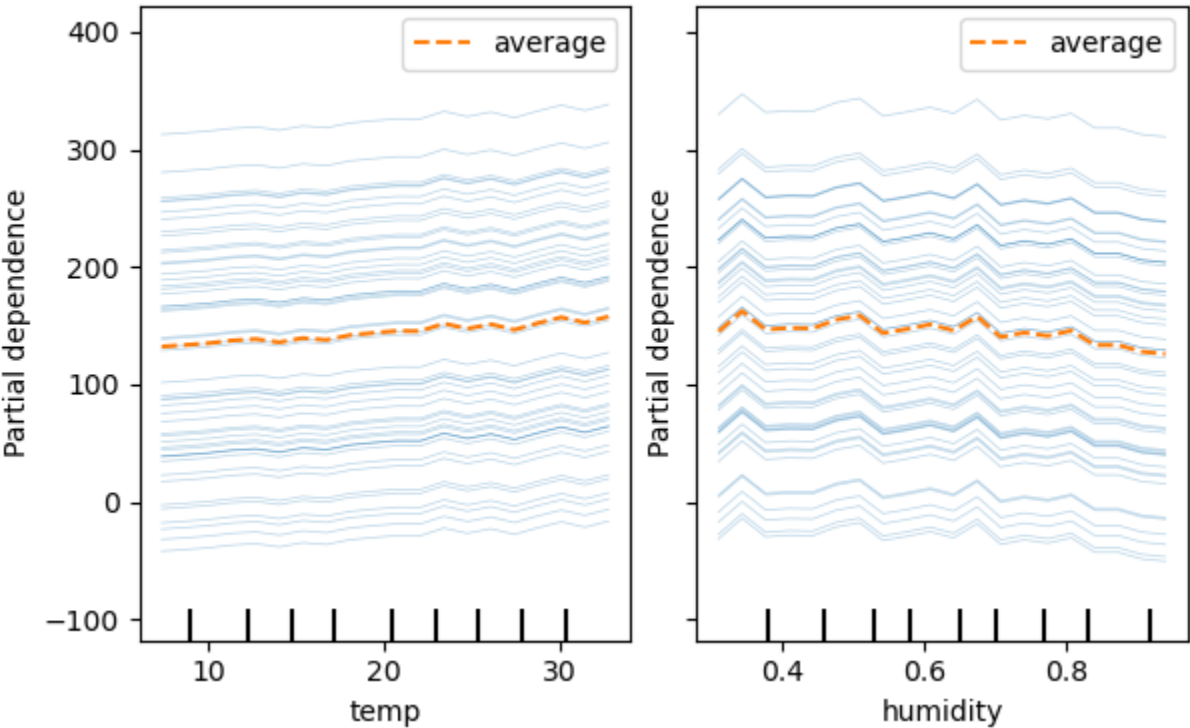
xgb_model.fit(X_train, y_train)
```


Modern Machine Learning for Time Series – XGBoost

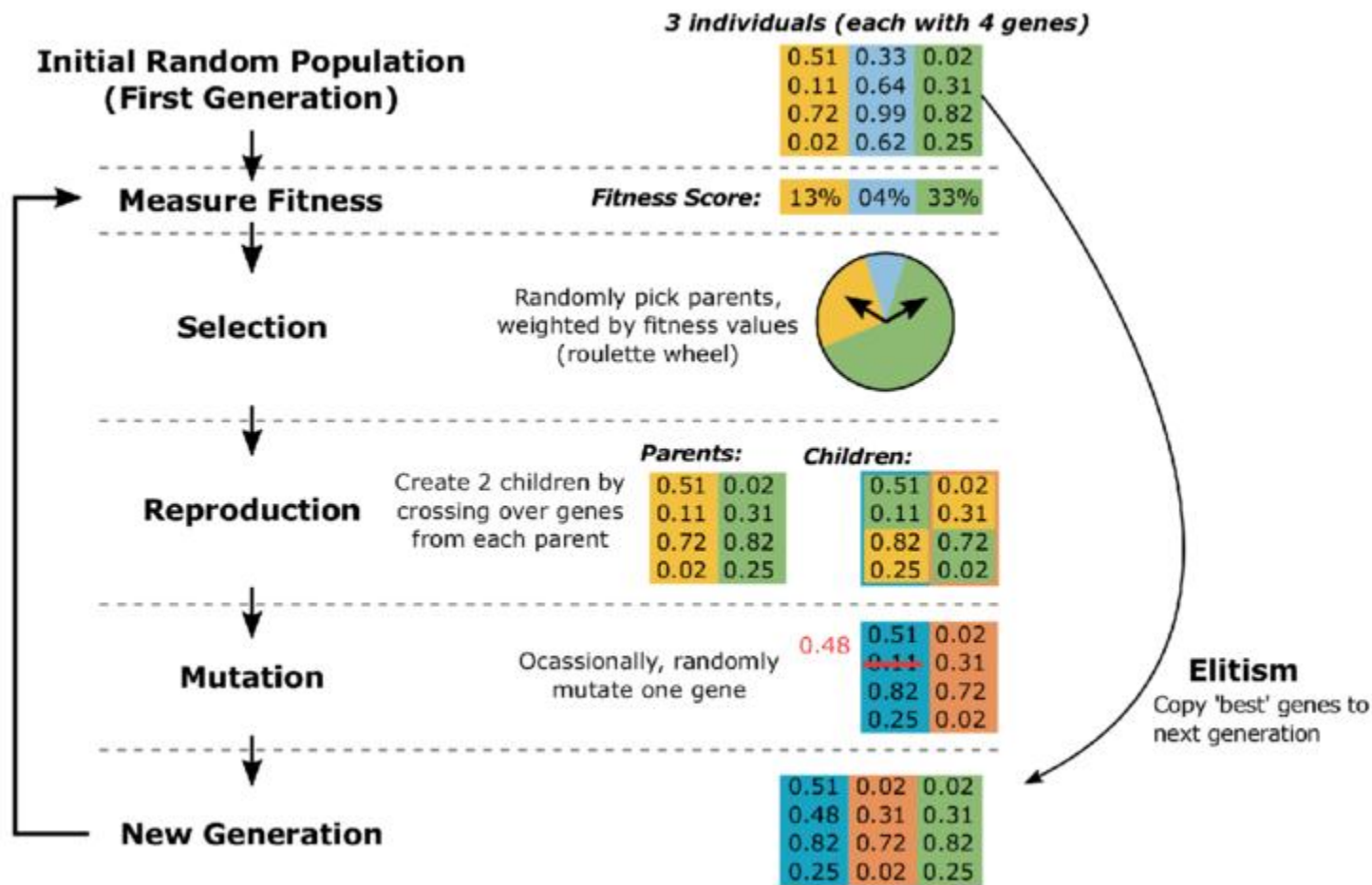


XGBoost Optimization – SHAP & Partial Dependency

ICE and PDP representations



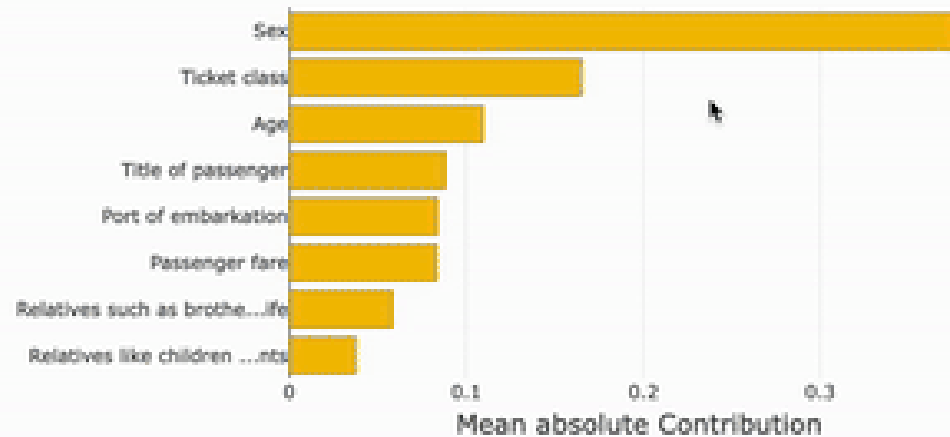
Optimization – NSGA II Genetic Algorithms





Features Importance

Response: Survival



Dataset

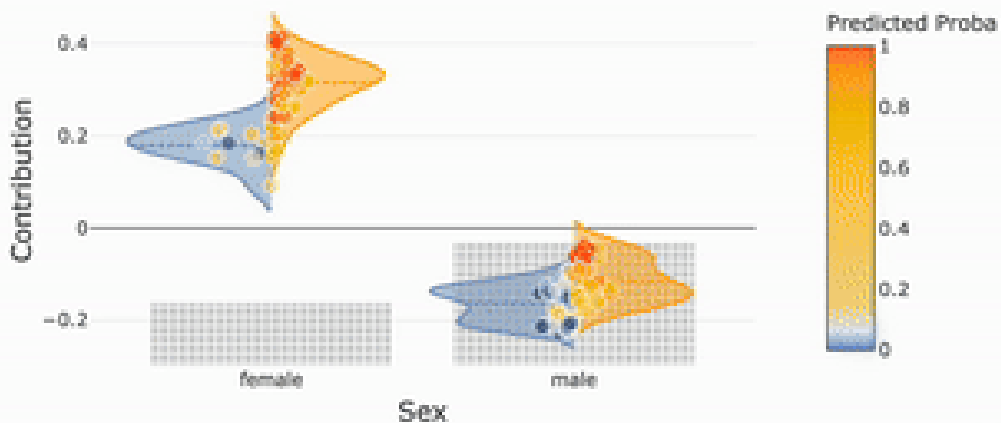
Dataset Filters

True Values Vs Predicted Values

index	_predicted_	_target_	Age	Embarked	Fare	Parch	Pclass	Sex
10	1	1	14	Cherbourg	30.1	0	Second class	female
14	0	0	39	Southampton	31.3	5	Third class	male
16	1	1	55	Southampton	16	0	Second class	female
21	0	0	35	Southampton	26	0	Second class	male
23	1	1	15	Queenstown	8	0	Third class	female
27	0	0	29.5	Cherbourg	7.2	0	Third class	male
35	1	0	28	Cherbourg	82.2	0	First class	male
47	0	0	29.5	Queenstown	15.5	0	Third class	male
49	1	0	29.5	Cherbourg	21.7	0	Third class	male
51	0	0	7	Southampton	39.7	1	Third class	male
54	1	1	29	Southampton	26	0	Second class	female

Sex - Feature Contribution

Response: Survival - Length of user-defined Subset: 223 (100%)



Select a valid single sample to display
Local Explanation plot.



index

Threshold: 0

0

Features to display: 8

1

4

8

Contributions to display:

☒ Positive☒ Negative

Feature(s) to mask:

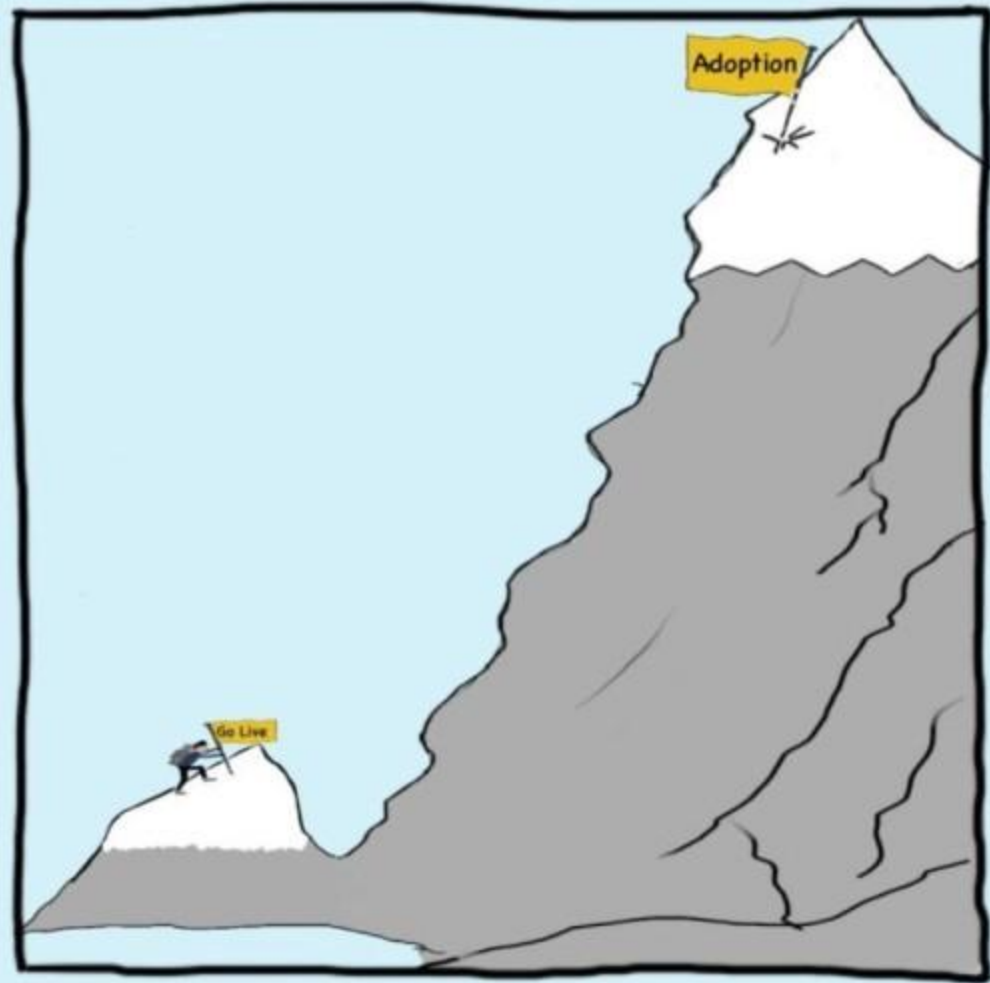
Select...

Reason #7



**Success
Doesn't End at
Launch**

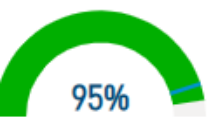




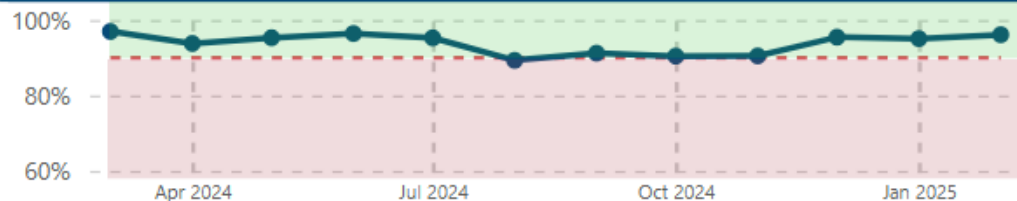
Implementation Roadmap



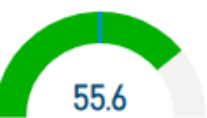
% Usage



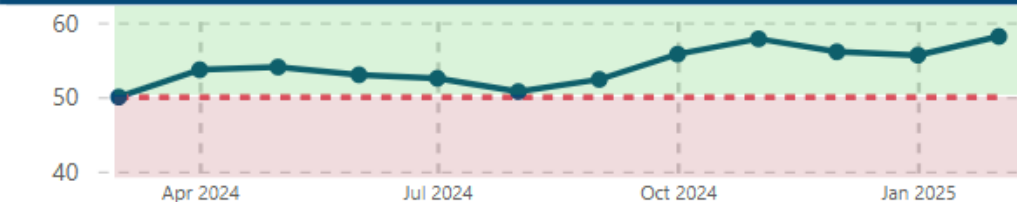
Percent of alarms that were acknowledged on the Actionboard | Target > 90%



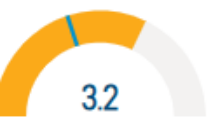
Response Quality



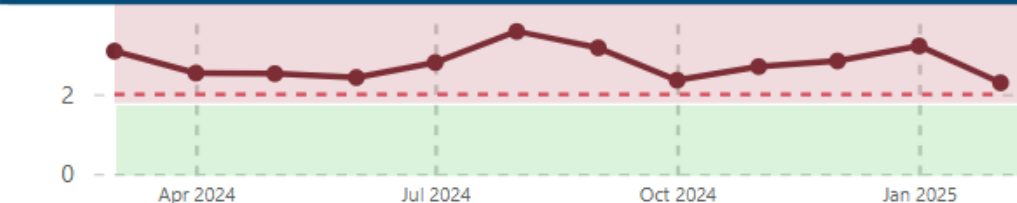
Avg # of characters in comments. Longer comments have more details and are more valuable | Target > 50



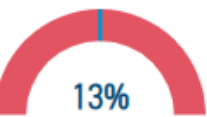
Response Hours



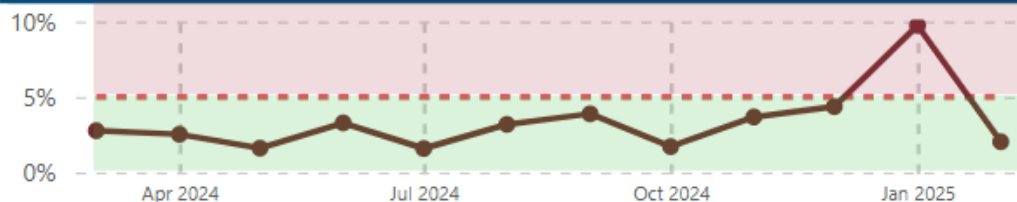
Average time from when the alarm appears on the actionboard until it has been responded to | Target < 2



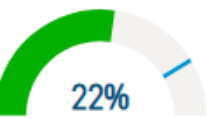
% Nuisances



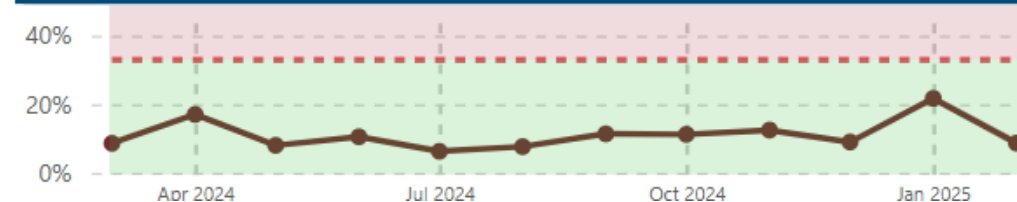
Percent of Nuisance alarms, as selected by operator | Target < 5%



% No Action



Percent of insights with no Corrective Action | Target < 33%



Month Selection for Gauges

Jan 2025

Range Selection for Charts

Last

12

Months

Actionboard

All

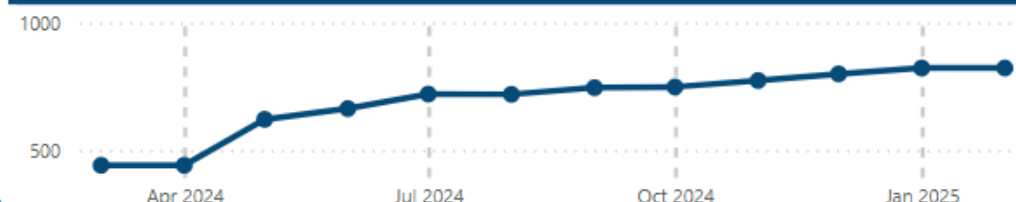
Phase

All

Increased Coverage Over Time



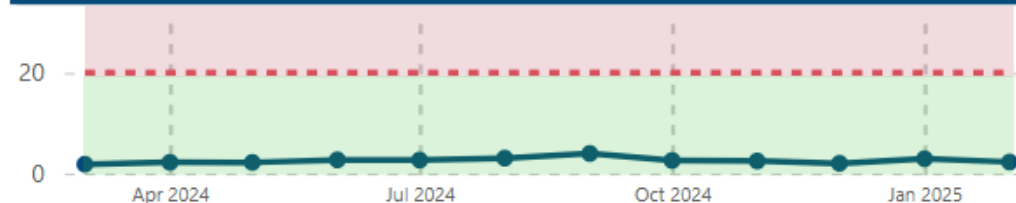
Count of charts with alarm over past month | Target > 5 additional charts per month



Insights per Hour



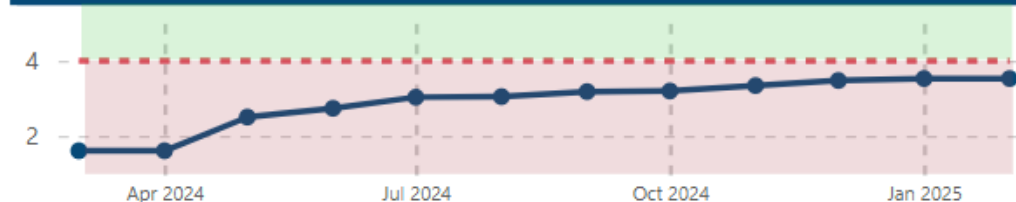
Average number of insights generated per hour | Target < 20



Unit Op Coverage



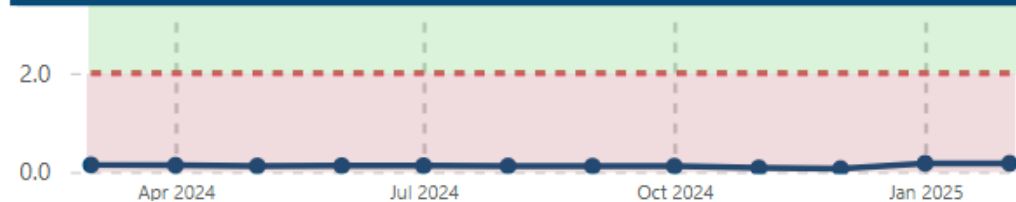
Total # of charts with alarms enabled divided by # of unit ops on the actionboards | Target > 4



SPC Alarms per UnitOp



Total # of charts with SPC alarms enabled divided by # of unit ops on the actionboards | Target > 2



Reason #8

A surreal landscape where a baseball field is built in the middle of a cornfield at dusk. The corn rows stretch out on either side of the field, leading towards a small barn and a house in the distance. The sky is a mix of orange, blue, and purple, with a few clouds. The text "If You Build it, They Won't Come" is overlaid in a large, dark blue font with a white outline.

**If You Build it,
They Won't
Come**

Digital Transformation Framework

The key elements to modernize your business

Leadership & Vision

Having a clear vision for the digital transformation journey and effectively communicating it to all employees

Digital Skills & Training

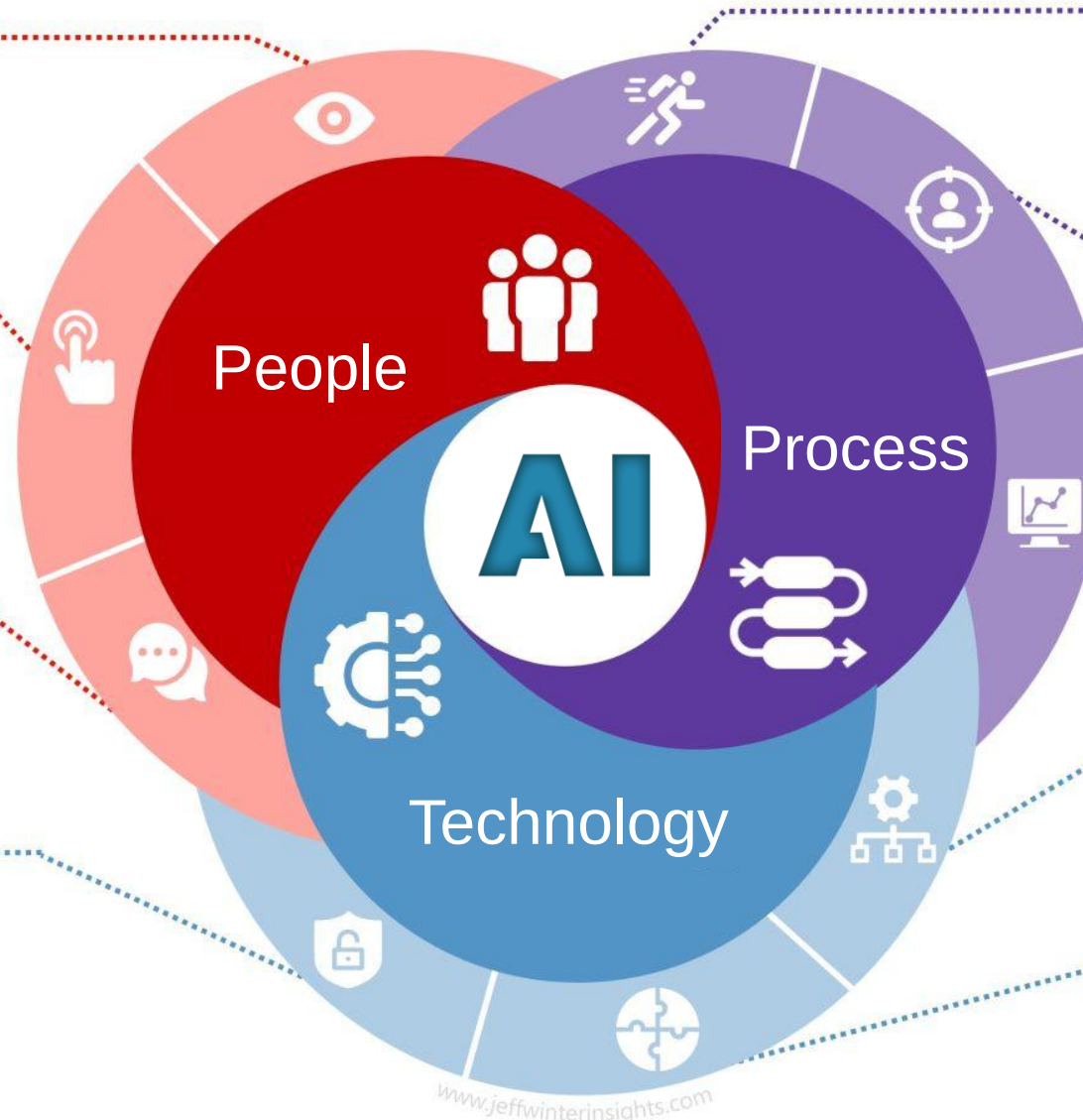
Equipping the employees with the necessary digital skills to navigate new technologies and tools

Collaboration & Communication

Fostering the right culture by breaking down silos, encouraging cross-functional teams, and facilitating knowledge sharing across the organization

Cybersecurity

Implementing strong cybersecurity measures to protect data, systems, and networks from potential attacks



Agile Methodologies

Implementing iterative and incremental approaches to project management and product development to be nimbler and more responsive to change

Customer-Centricity

Adopting a design thinking approach and continuously seeking feedback from customers

Data-Driven Decision-Making

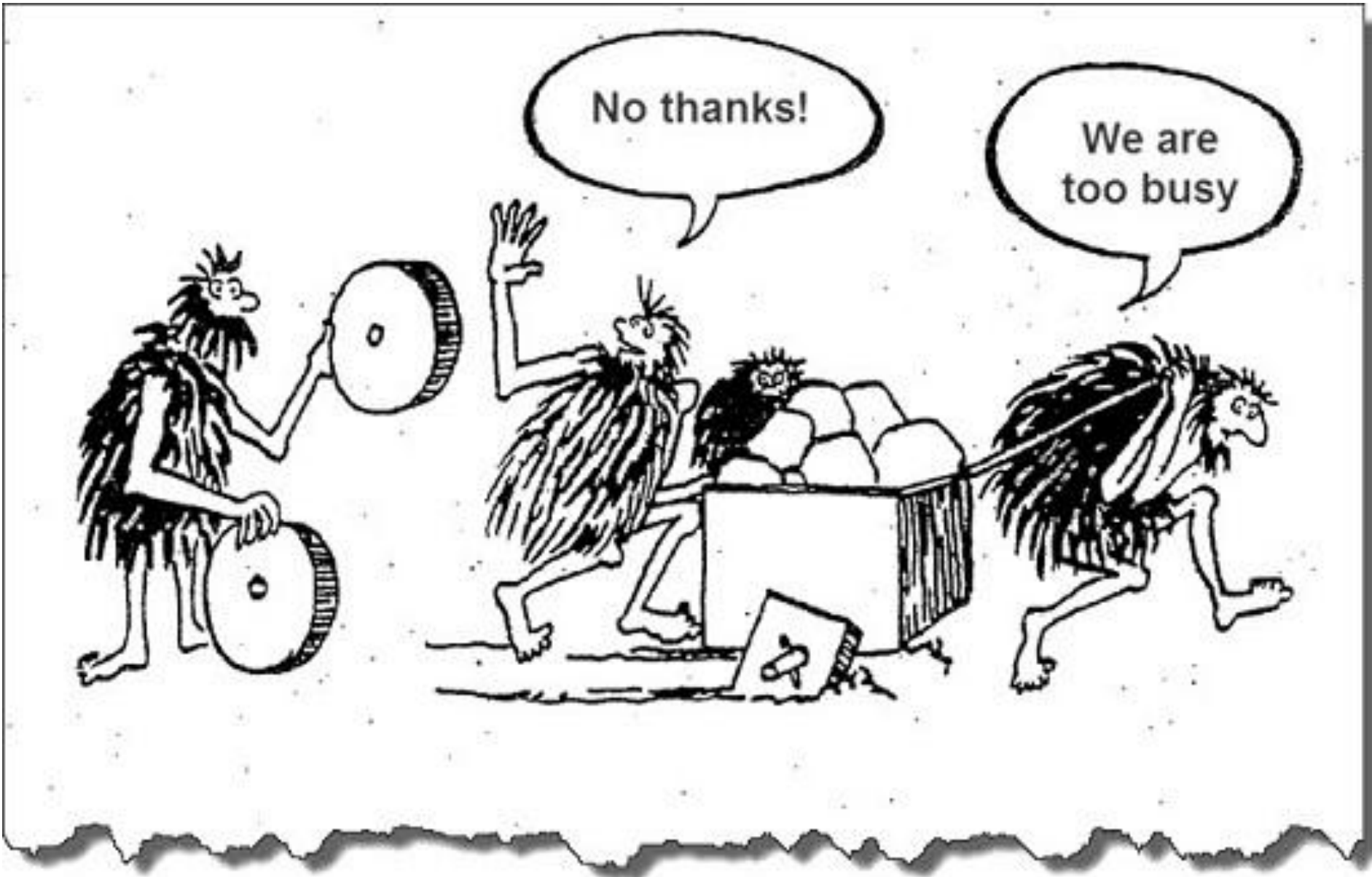
Leveraging data and analytics as an integral part of decision-making processes

Infrastructure

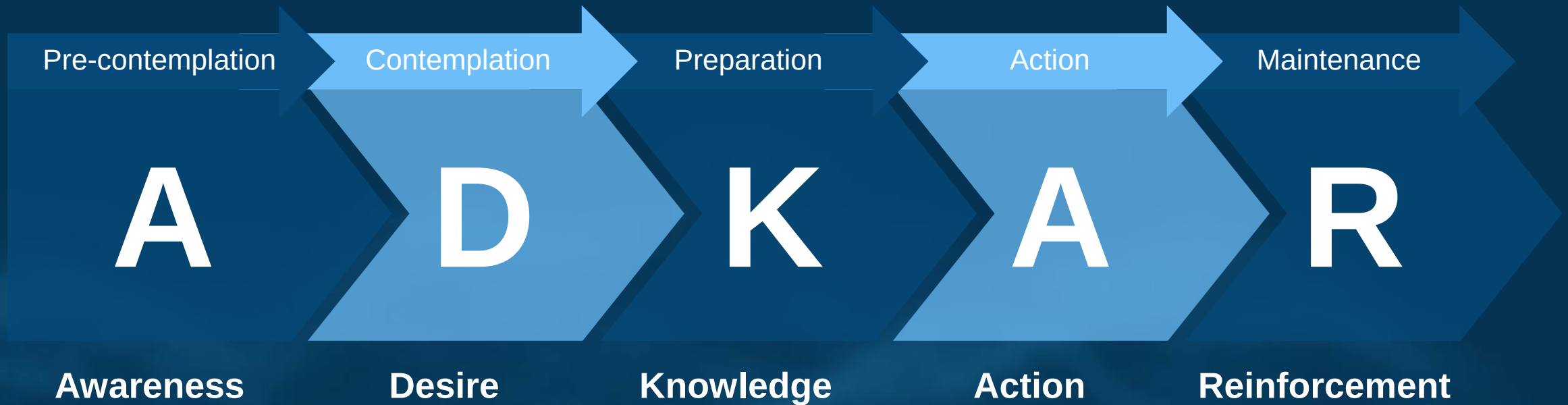
Investing in a robust and scalable digital infrastructure that can support the organization's needs

Integration

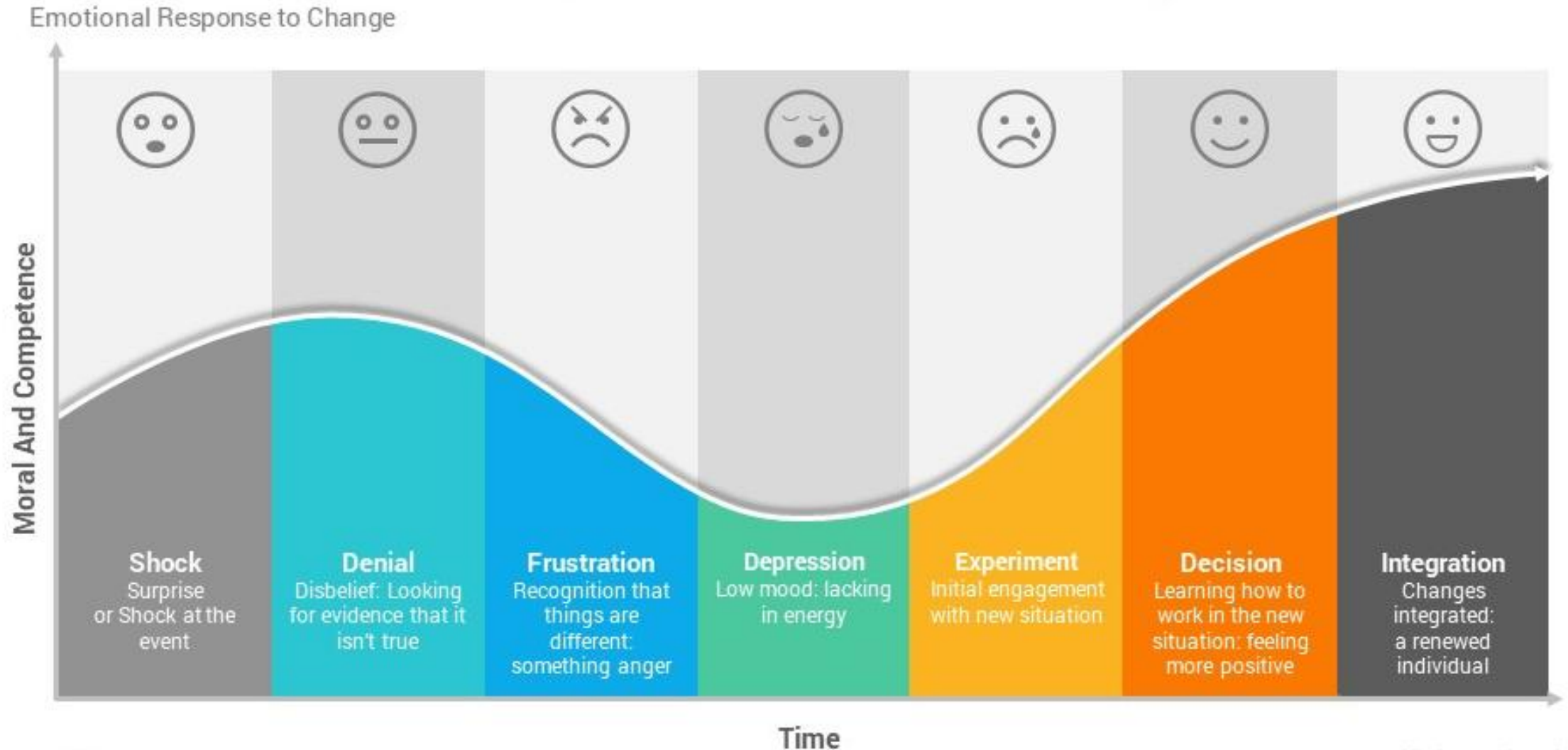
Ensuring seamless integration of different systems and platforms across business functions

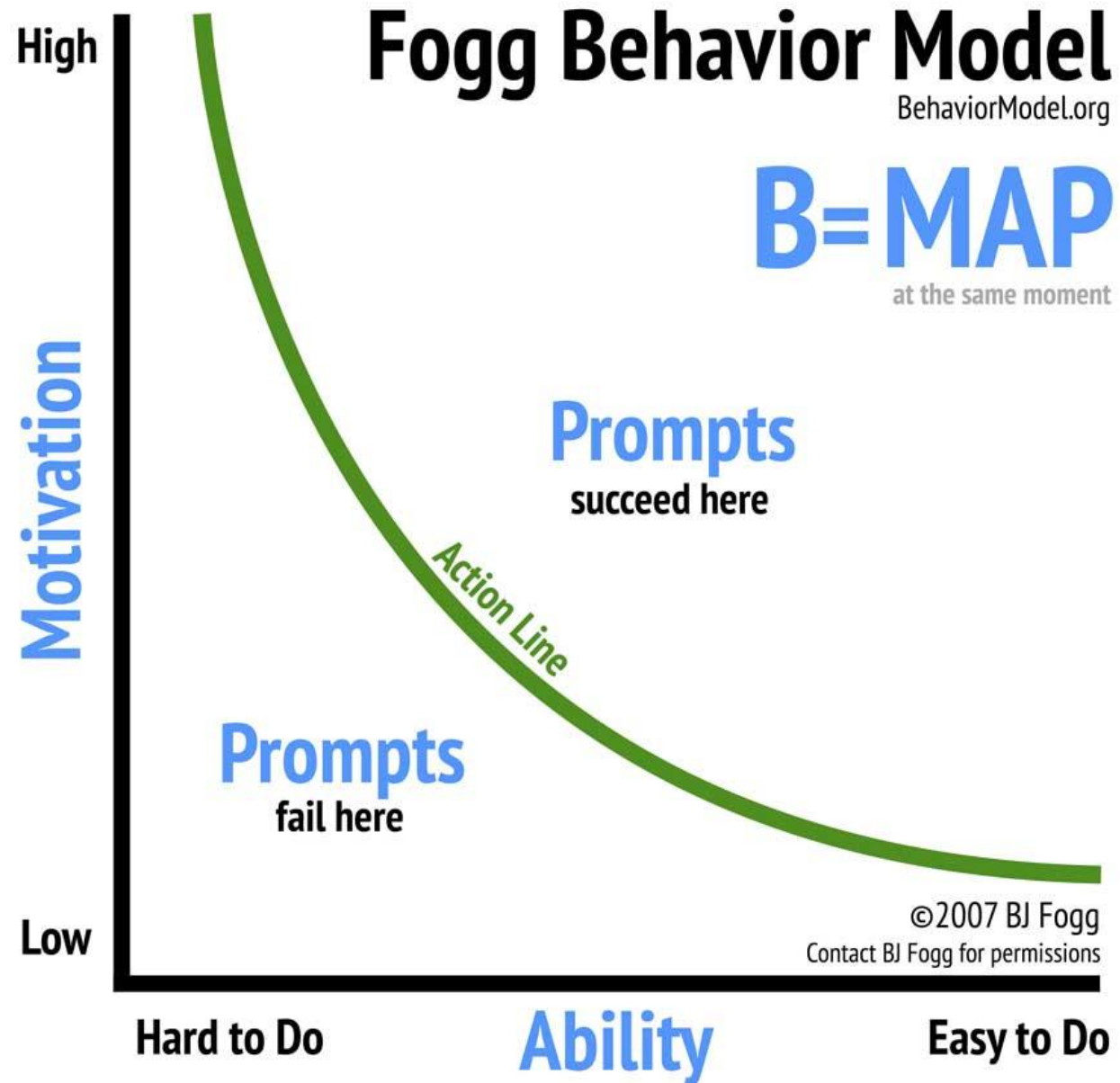


ADKAR Change Management



Kübler-Ross Change Model Curve Template





Reason #9

A detailed still life of a breakfast meal on a dark wooden table. The central focus is a large plate with a stack of pancakes topped with a fried egg and syrup, accompanied by scrambled eggs, bacon, and toast. Surrounding this are various other items: a pitcher and glass of orange juice, a cup of coffee with a dusting of powder, a stack of pancakes, a plate of bacon, a bowl of toast, and several small bowls of condiments like syrup and butter. Sliced oranges and coffee beans are scattered around the table, adding to the rustic and appetizing feel.

Culture Eats Strategy for Breakfast

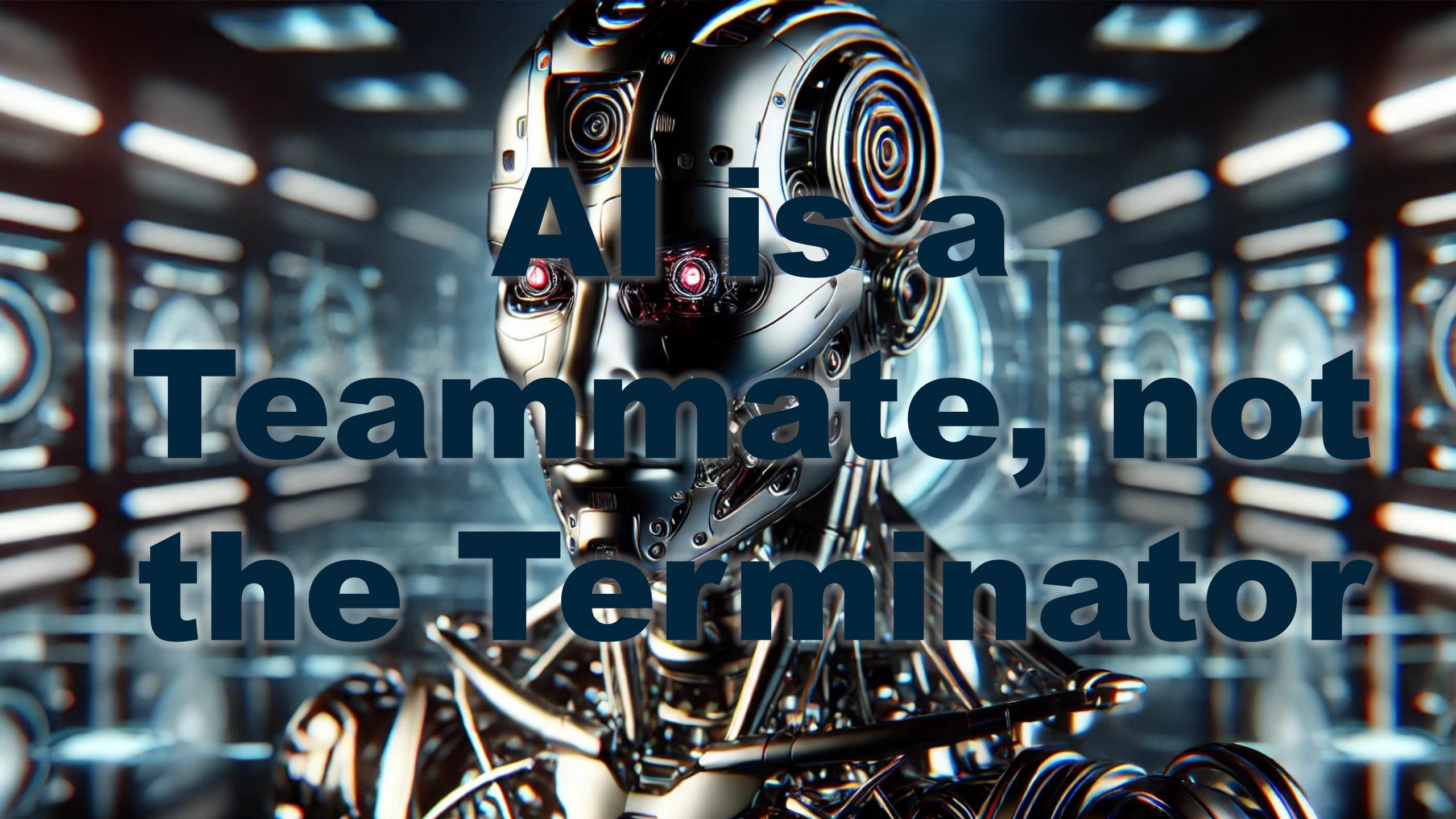








Reason #10



**AI is a
Teammate, not
the Terminator**



AI

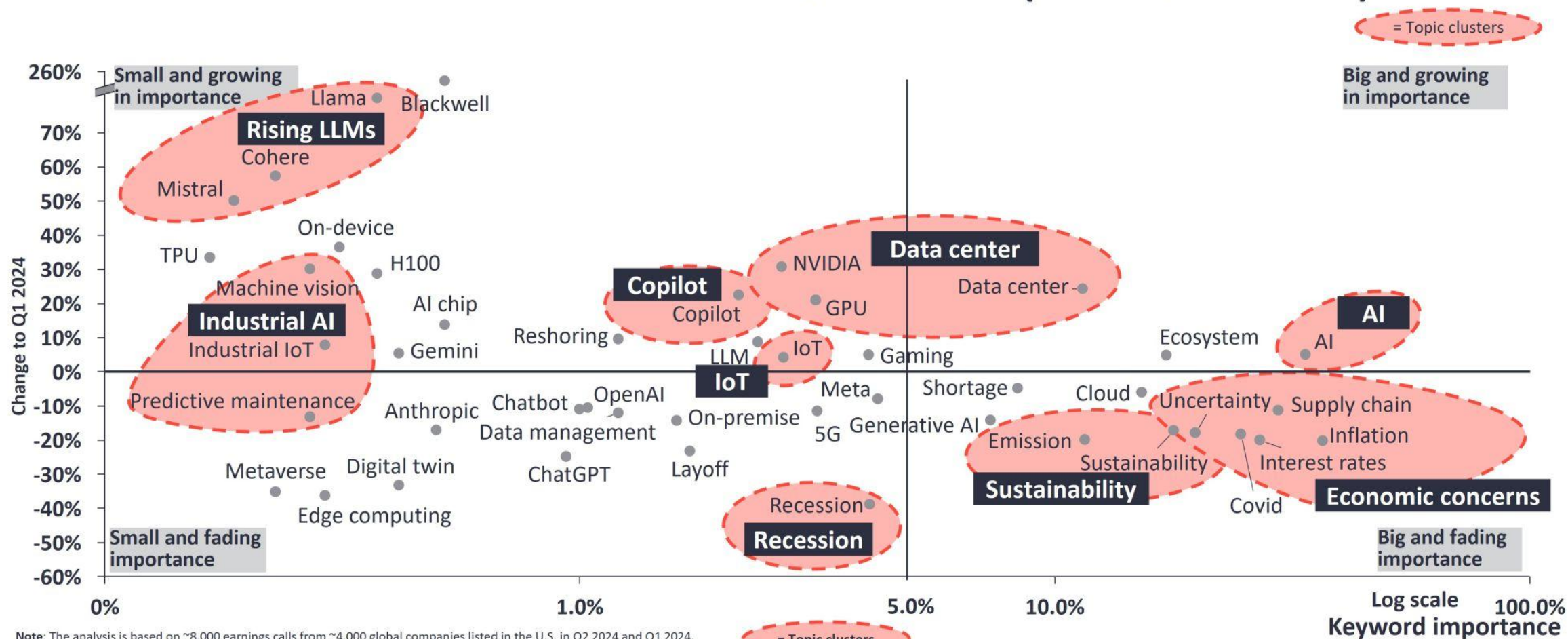
010101 0101 010101 0101

0101

01010101 0101 010101

01010101 0101 010101 0101

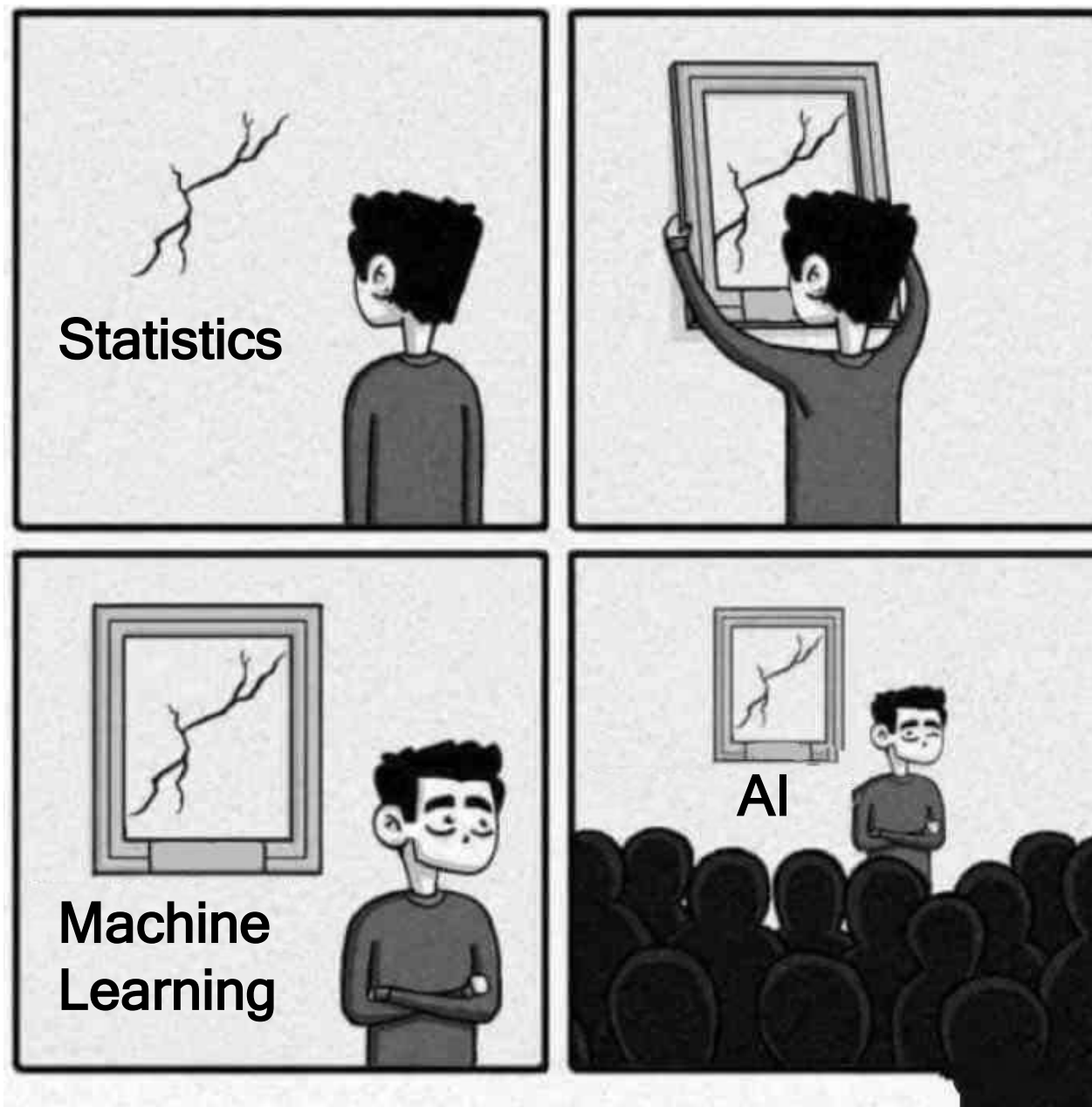
What CEOs talked about in Q2 2024 (vs. Q1 2024)



Note: The analysis is based on ~8,000 earnings calls from ~4,000 global companies listed in the U.S. in Q2 2024 and Q1 2024. The mentions of the selected keywords in each call were counted in each quarter.

Source: IoT Analytics Research 2024 – We welcome republishing of images but ask for source citation with a link to the original post and company website.

(Share of companies that mentioned the keyword in Q2 2024 at least once)



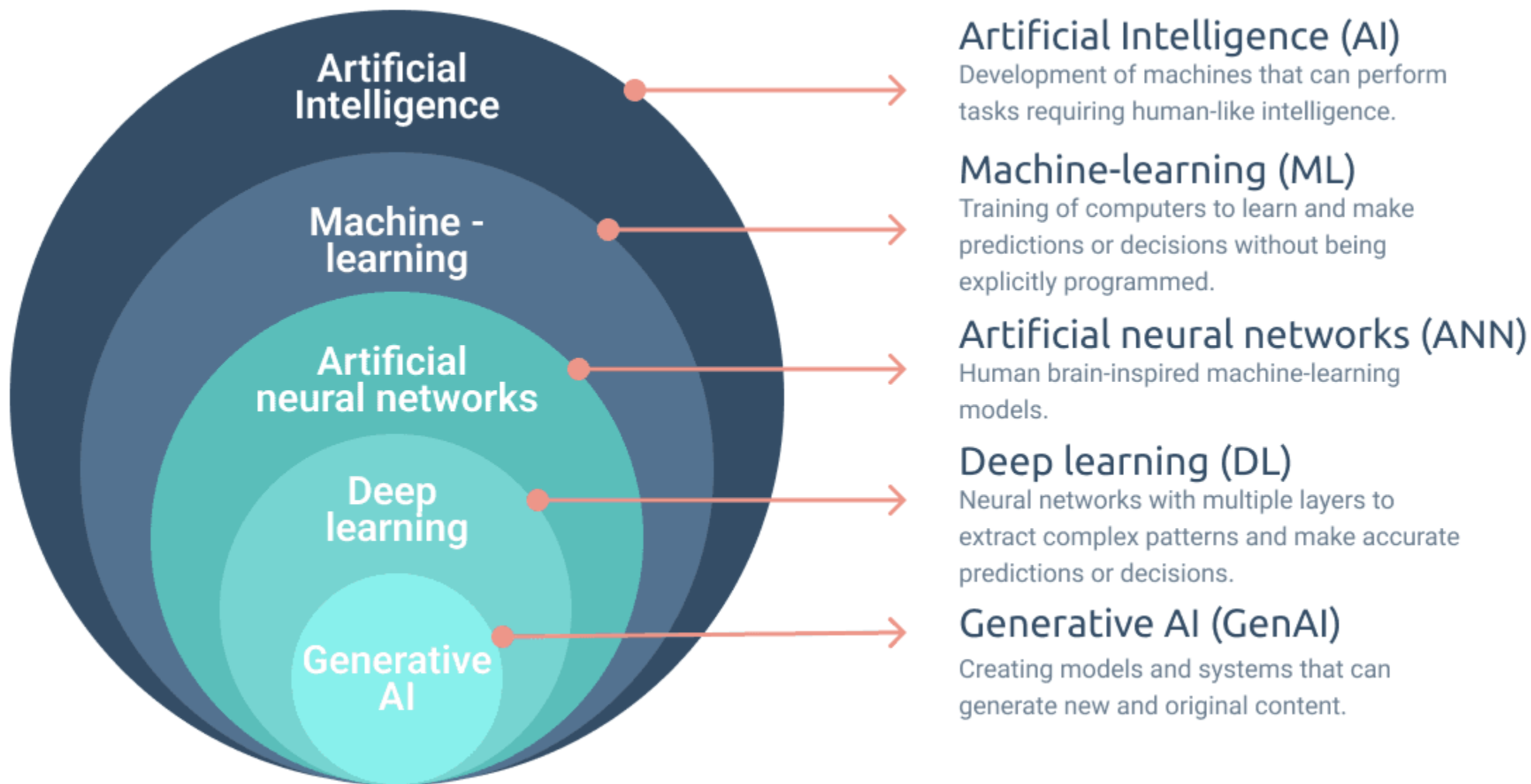


Image 2. AI subsets



*Ensure that artificial
general intelligence (AGI)
benefits humanity.*

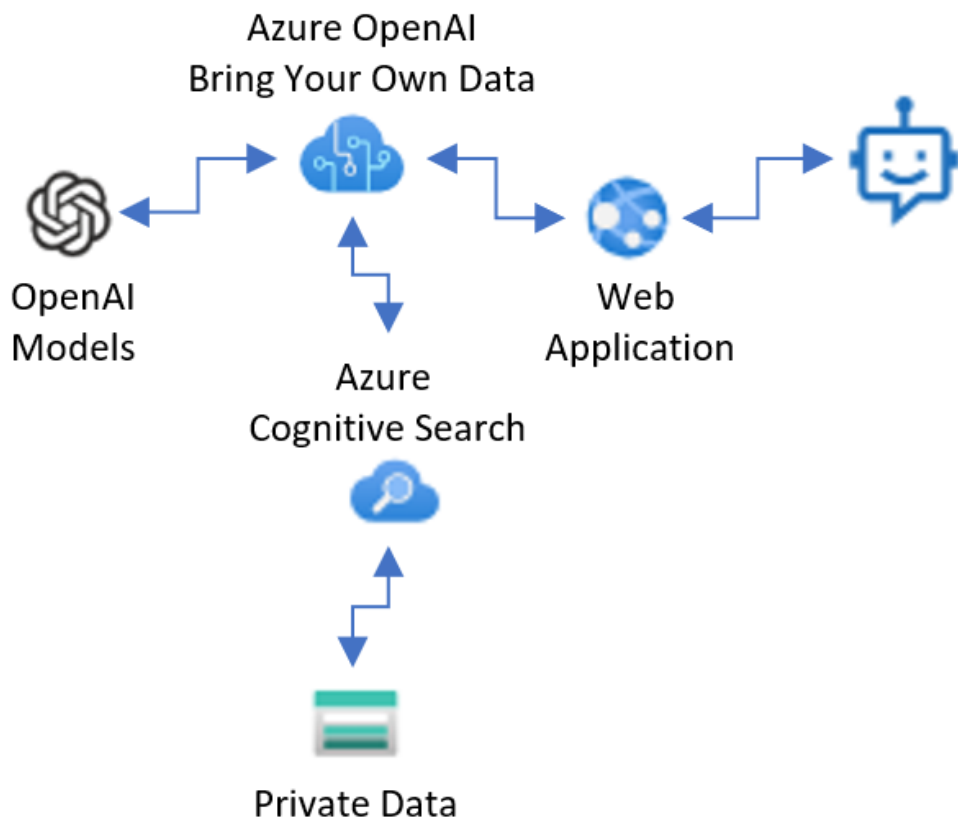


Microsoft

*Empower every person and
organization on the planet
to achieve more*



Azure OpenAI Service



Enterprise-grade, scalable infrastructure



Custom AI models fine-tuned with your data and hyperparameters



Enterprise-grade security with role-based access control and private networks



Built-in responsible AI to detect and mitigate harmful use



Chat with your data

Ask anything or try an example

Where does my raw water pump get its water from?

What modes does my BMS have on my calciner?

How does my fuel/air ratio control work for my calciner burner?



Type a new question (e.g. does Functional Control Description include Software standards?)



■ Hey Chat GPT,
finish this building...

■ Hey Chat GPT,
finish this building...

Your skills are irreplaceable.

IMPACT

Satisfying jobs in construction and trade



Apply on
impact.be



Apply on
impact.be







Automated Information
Analytics Innovation
Actionable Insight



Albemarle People
Empowered by Technology
Unlocking the value of information



AUTOMATIZACIÓN DE LA INFORMACIÓN

ANALÍTICA CON INNOVACIÓN

ACCIONES INFORMADAS

**INTELIGENCIA
ALBEMARLE**



Personal de Albemarle,
Empoderados por la Tecnología,
Liberando el Valor de la Información



雅保智能

自动信息

分析创新

切实可行的洞察



雅保人，
技术赋能，
释放信息的价值

Albemarle creates 25 Million Event Frames, with estimated improvements >\$150 million annually

Challenge

- Hundreds of thousands of data points
- Manual data sharing and reporting processes led to information bottlenecks
- Massive manufacturing growth and demand – fueling the need for more efficient manufacturing processes

Solution

- Deployed a massive, standardized implementation of the full AVEVA™ PI System™
- Created Albemarle Intelligence Program, merging the experience and skillset from all of our manufacturing employees, with world-class technology

Results

- >\$150 million in estimated annual improvements



Albemarle
PEOPLE
Empowered by
TECHNOLOGY
To unlock the
VALUE
of information

AVEVA



Jonathan Alexander

Manufacturing AI & Advanced Analytics Manager
Albemarle

jonathan.alexander@albemarle.com



