

CPS Digital Twin & Simulation

Pilot Project Sharing
Andrew Tan



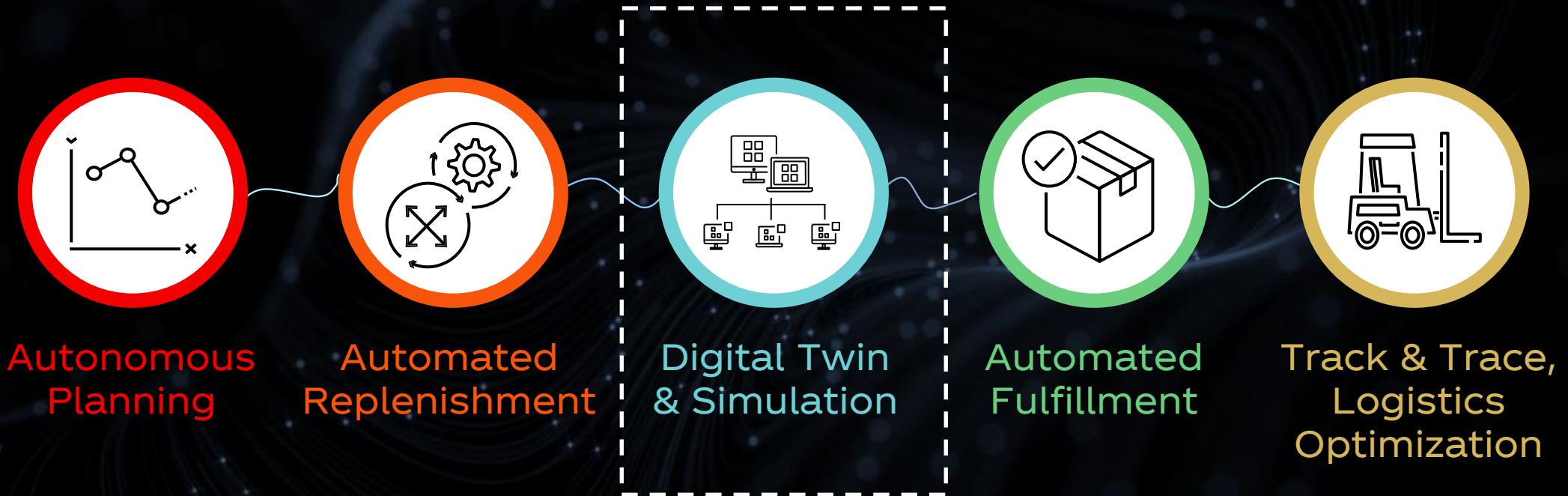
Agenda

- Project Background
- 3 Work Areas
 - UI/UX & Storyboard
 - Architectural Design
 - Data & ML
- Timeline
- Future Scale & Replicate
- Q&A

The background is a dark, almost black, space filled with intricate, glowing patterns. These patterns consist of numerous thin, curved lines that flow and swirl across the frame, creating a sense of dynamic movement. Interspersed among these lines are many small, bright white dots, some of which appear to be part of the lines themselves, while others are standalone. The overall effect is reminiscent of a complex network, a data visualization, or perhaps a stylized representation of a celestial map or a microscopic structure. The lighting is soft, with the glowing elements providing the primary source of illumination against the dark backdrop.

Project Background

We are transforming the way we work bringing to life a **digital thread** that connects the entire supply process



OUR GOAL IS TO BE RECOGNIZED AS A **WORLD-CLASS, INTEGRATED SUPPLY CHAIN PARTNER**, ENABLING OUR SYSTEM TO DELIVER AGAINST OUR GROWTH AGENDA WITH IMPROVING MARGINS

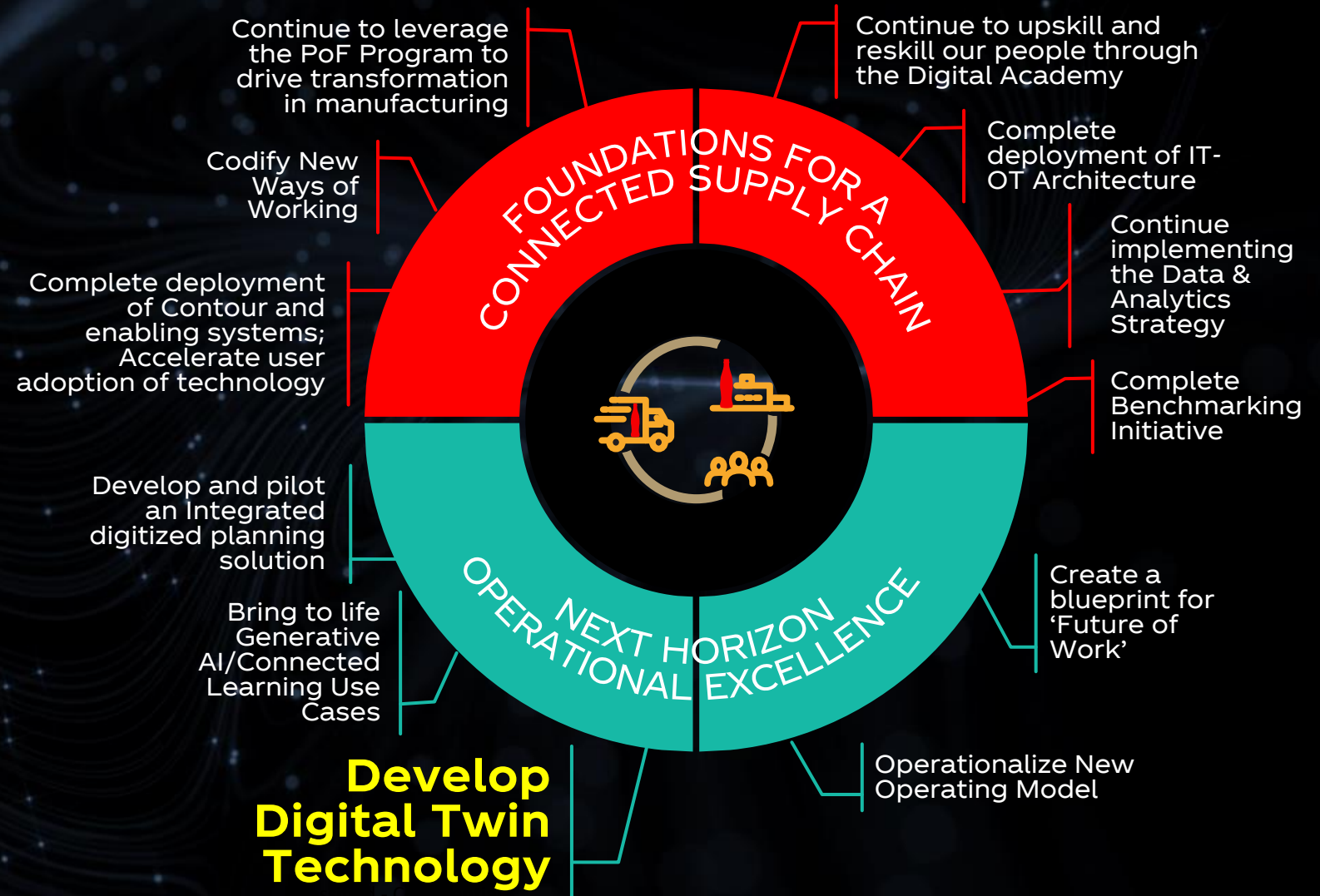
To achieve our strategic objectives, we will focus on **two imperatives** in 2024



STRATEGIC IMPERITIVES

Complete building the foundations for a connected supply chain

Scale the next horizon of operational excellence



The Ask

Build a minimum viable product (MVP) in partnership with a solution provider (Microsoft), to demonstrate that the application of digital twin technology can deliver operational efficiency, production capacity and cost effectiveness:

- *Depict operational states of critical assets and processes on the Drones 1 Line in CPS Puerto Rico.*
- *Deliver a scalable, well-architected solution that supports fast-follow Pilot evaluation*
- *“Demonstrate significant lift to productivity.” (OEE overall in plant is currently mid-30s to mid-40s.)*





Drum Loading
&
Labelling

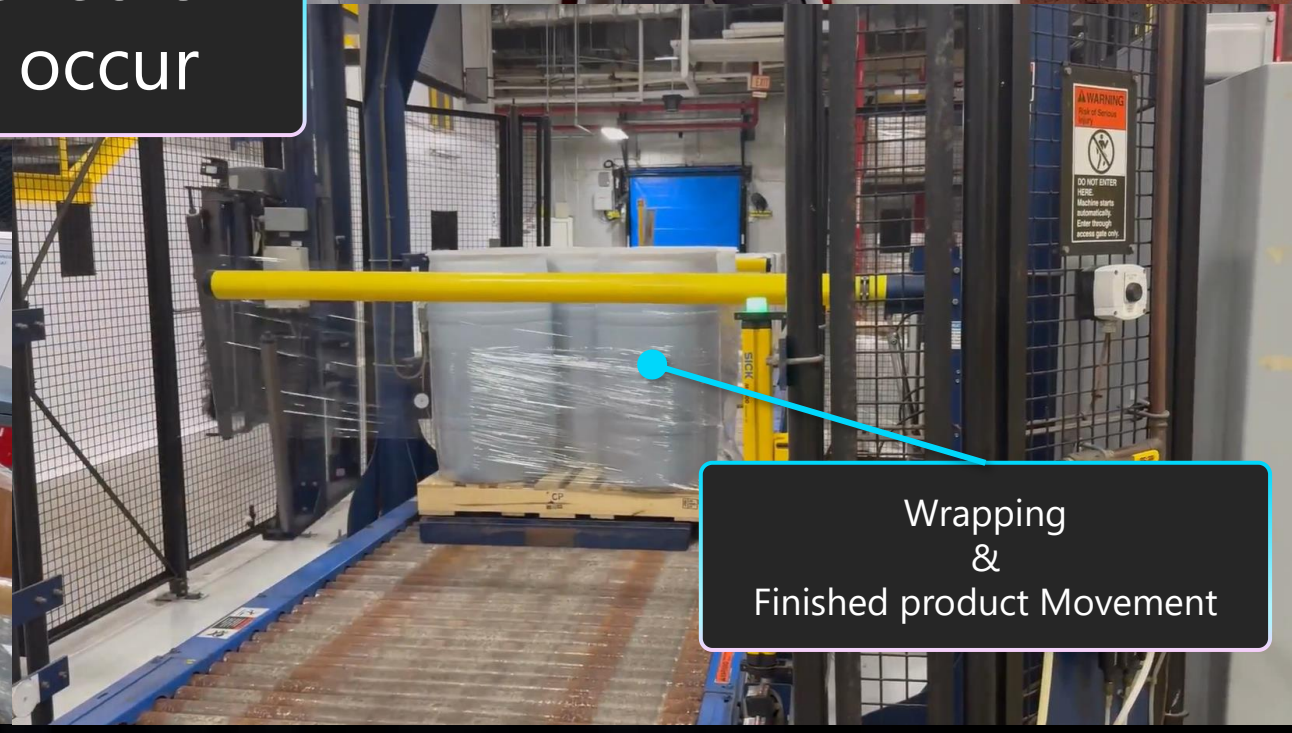


Filling

Bottlenecks
often occur



Capping



Wrapping
&
Finished product Movement

What we have observed from site visit + Persona Interviews

Frontline worker Challenges

Different processes by different people in the same role.

Lack of visibility to key information to make real time decisions and improve OEE.

Lack of awareness or information between teams without a chase down or call.

Process Challenges

Lack of automation to key parts of the line.
Opportunity to improve speed with automation optimizations

Opportunity to have better forecasting for inventory and materials tracking.

There are manual processes that have an impact on OEE.

Current Pilot Project Proposal

The development of an MVP (minimum viable product) of an “Industrial AI Factory” (Digital Factory) of the Drones 1 filler line including a 3D visual representation of the lines, a performance dashboard with **predictive capabilities**, and a **natural language interface** that provides answers to questions in **real-time**.

This will empower **Line Coordinators and Operators** with a mobile-enabled solution to receive important alerts, make informed decisions by interacting with near-time and historic information, view problems visually, and efficiently adjust as needed.

This approach is based on learnings from...



The background is a dark, almost black, space filled with intricate, glowing patterns. These patterns consist of numerous thin, curved lines that sweep across the frame, often ending in small, bright white dots. The lines and dots are arranged in a way that suggests a sense of movement and flow, reminiscent of a stylized nebula or a complex network of data. The overall effect is one of depth and dynamic energy.

3 Work Areas

Enabling an Industrial AI Factory – what to expect?

Work Area 1



Industrial AI Factory Foundations

Key Objectives

- Capture site environment - physical infrastructure and operational processes
- Evaluate plant data estate - key data sources for target use cases
- Build and deploy foundational architecture to enable success of WA2 and WA3

Design Activities

- **Infrastructure & Process Mapping:** Conduct comprehensive surveys and audits of the physical layout, systems and operational processes at site.
- **Solution Architecture Design:** Design the initial architecture.
- **Azure Subscription + Tenant Access:** Provide access to developers to Azure to setup = (Horizon)
- **Build Initial Sprint Plan**

Build Activities

- **Azure Resource Deployment:** Deploy the resources required for Industrial AI Factory TCCC subscription
- **Develop target features:** Develop key enabling features to enable use case and required functionality
- **Tight Collaboration and Integration with WA2 + 3:** Work closely with the data scientists and UX developers on end-to-end solution

Test + Refine Activities

- **Continuous Testing and Refinement:** Throughout the project work closely with end users on testing and ensure value realization

Work Area 2



Data Exploration & Modelling

Key Objectives

- Define UNS and other underlying data models
- Data engineering and model implementation
- Insights and Use Case development
- Integrated real-time data flows and rapid model refinement
- Possible Integration of existing/legacy dashboards
- Refined Use Case design based on validation process and SME feedback

Design Activities

- **Data Estate Deep Dive:** Review data sources relevant to each use case. Understand key data properties such as schema, update frequency, accessibility, ...
- **Process and Use Case Deep Dive:** Understand the existing process and workflow.
- **Data Exploration for ML/AI:** Analyze historic data extract to validate assumptions and create high level model approach.

Build Activities

- **Data Preparation and Engineering:** Transform data into formats needed for each use case
- **Data Modeling and Algorithm:** Train models and develop use case algorithm.
- **Tight Collaboration and Integration with WS1 + 3 :** Integrate data and model pipelines with real time data flows. Ensure model outputs are contextualized and available for end user usage.

Test & Refine Activities

- **ML Ops Pipeline:** MLOps/DataOps/CICD pipeline deployment
- **SME Feedback Iteration:** Based on SME feedback, iterate on the model and calculations.

Work Area 3



End User Experience

Key Objectives

- Design intuitive, modular UX experience to surface data and insights to target personas
- Build and integrate line visualization with data overlay
- Integrate Natural Language Copilot Interface
- Ensure continuous iterative feedback and testing with end users to ensure value realization and employee adoption

Design Activities

- **UX Design:** Design and refine UX designs for Industrial AI application with end users. Includes sync with TCCC brand themes / toolkit
- **3D Modelling:** Utilize 3D models for "Digital Twin" evaluating various content curation options

Build Activities

- **Develop target features:** Develop key enabling features to end user experience
- **Tight Collaboration and Integration with WA2 + 3:** As data and insights are unlocked test integration and performance with consumption experience

Test & Refinement Activities

- **Continuous Testing and Refinement:** Throughout the project work closely with end users on testing and ensure usability, value realization
- **End user Feedback Iteration:** Based on End User feedback, iterate on the solution

Development Team Structure





UI/UX & Storyboard

Storyboard (1 of 3)



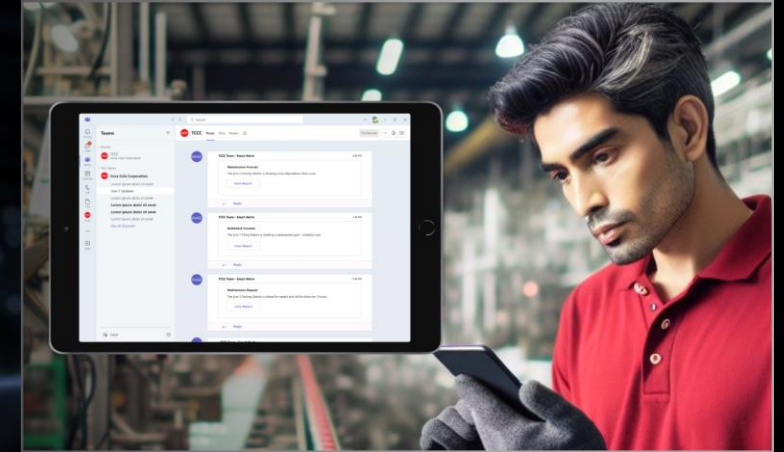
1. Alert Notification: Alert detected on the production line

1) Alert Notification:
An issue proactively detected on the production line



2. Synced Alerts: Manager and Line Coordinator receive alerts simultaneously

2) Synced Alerts:
Manager and Line Coordinator receive alerts simultaneously



3. Taking Action: Line Coordinator clicks on the alert link

3) Taking Action:
Line Coordinator jumps into action and clicks on the alert link

Storyboard (2 of 3)



4) Assessment:
He assesses the situation using detailed charts in Teams App



5) In-Depth & Details:
He can zoom out to view other charts and 3D Alerts



6) Leveraging Chatbot:

He asks the chatbot for additional information to support his journey to corrective action

Chatbot available through Teams - App

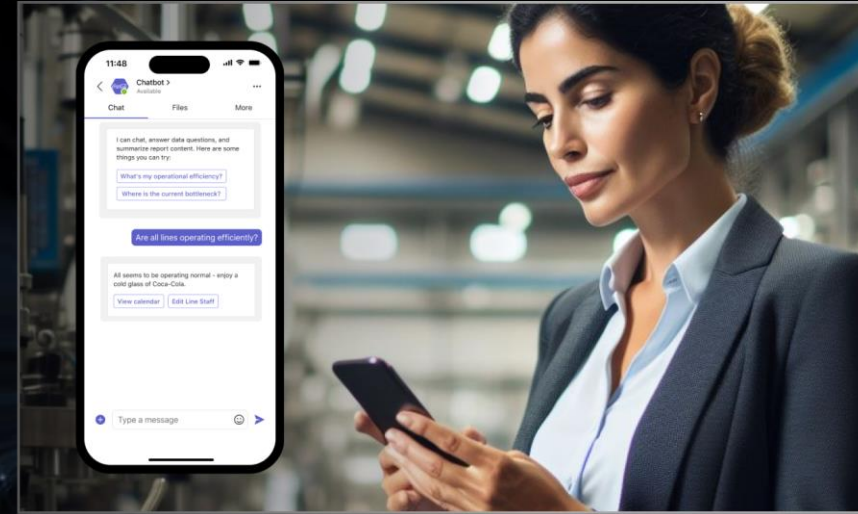


Storyboard (3 of 3)



6) Coordination:

He collaborates with the Line Operator to make adjustments



9. Remote Connectivity: The Production Manager checks the status during a meeting break. She asks quick questions via teams chatbot to understand line performance and sees the line is on track to meet their targets!



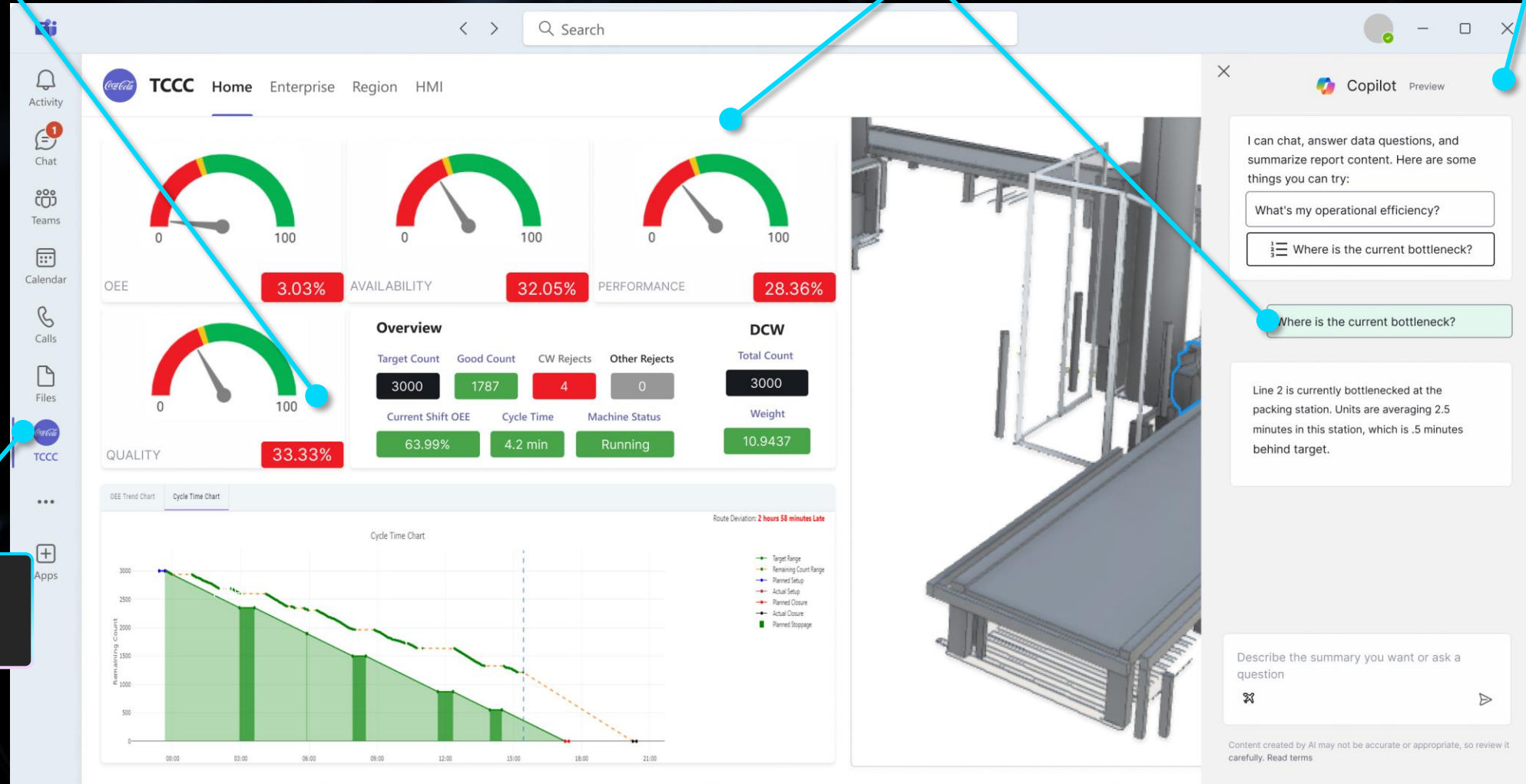
Teams App

Leveraging existing analytics dashboards

Contextualised alerts, historic, real time and predictions

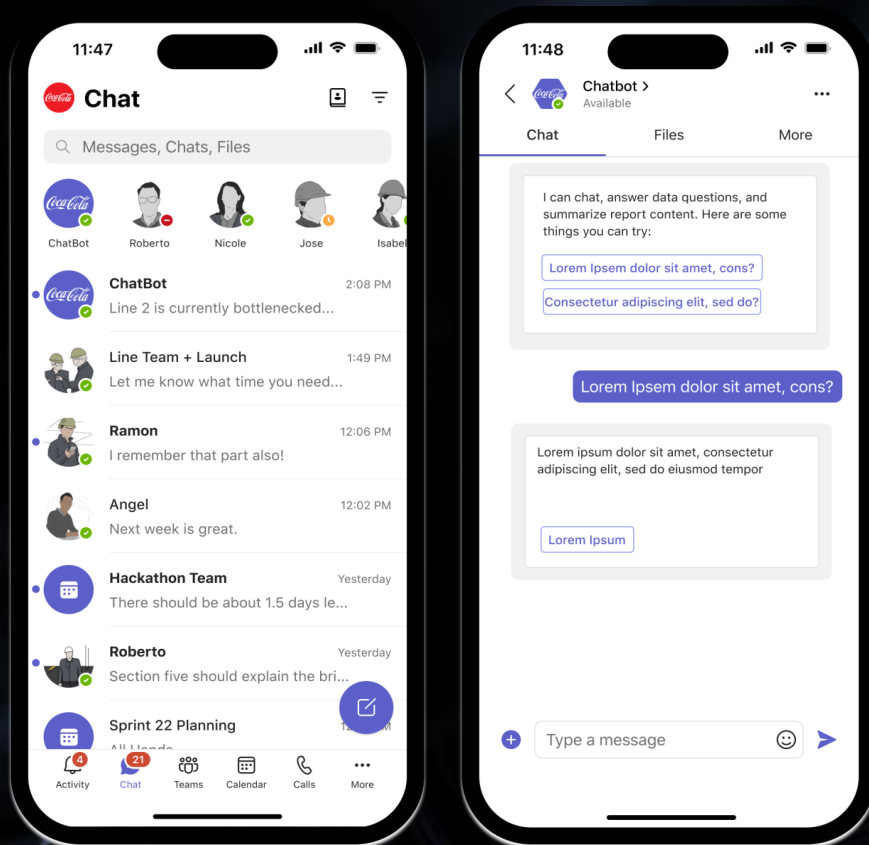
Natural Language Interface

Integrated into Teams



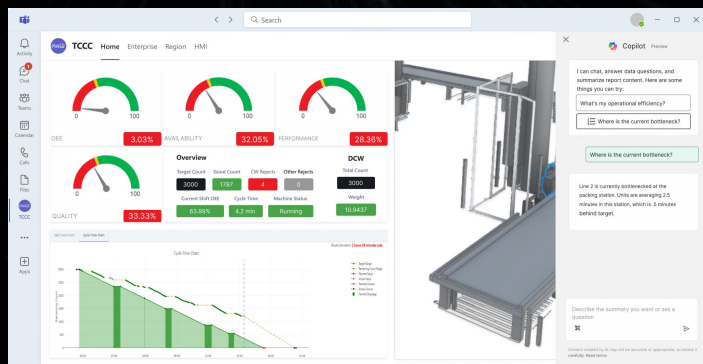
Modular views, 2D, 3D, Text, External visuals

Chatbot available through Teams + App



Priority Target Questions

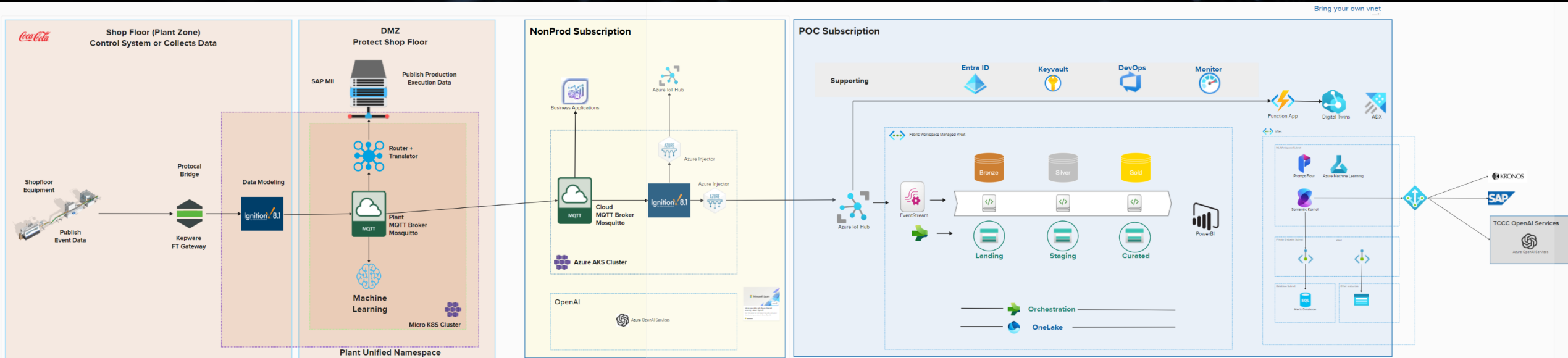
- Were there any issues with the previous shift on **<line>**?
- How many stoppages have there been on **<line>** in the past week?
- What was the average efficiency of the **<line>** over the past 7 days?
- What has been the main bottleneck on **<line>** during **<first or second shift>**?
- What is the progress of **<line>**?
- Show me the status of **<maintenance notification number 122>**
- What is the breakdown of stoppages for the week?
- Are any of my runs behind schedule?



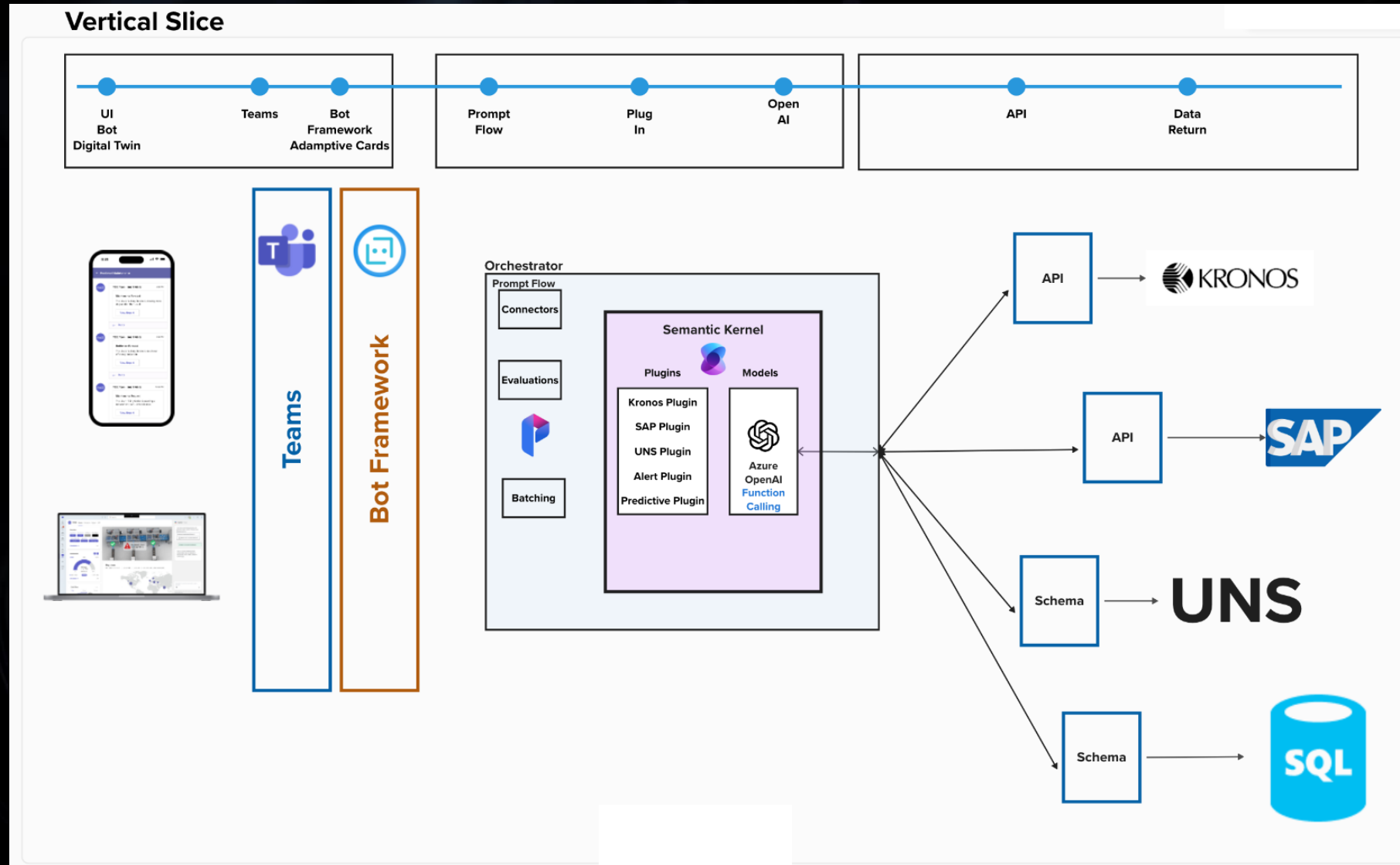
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Architecture

Overall System Architecture



Platform Integration

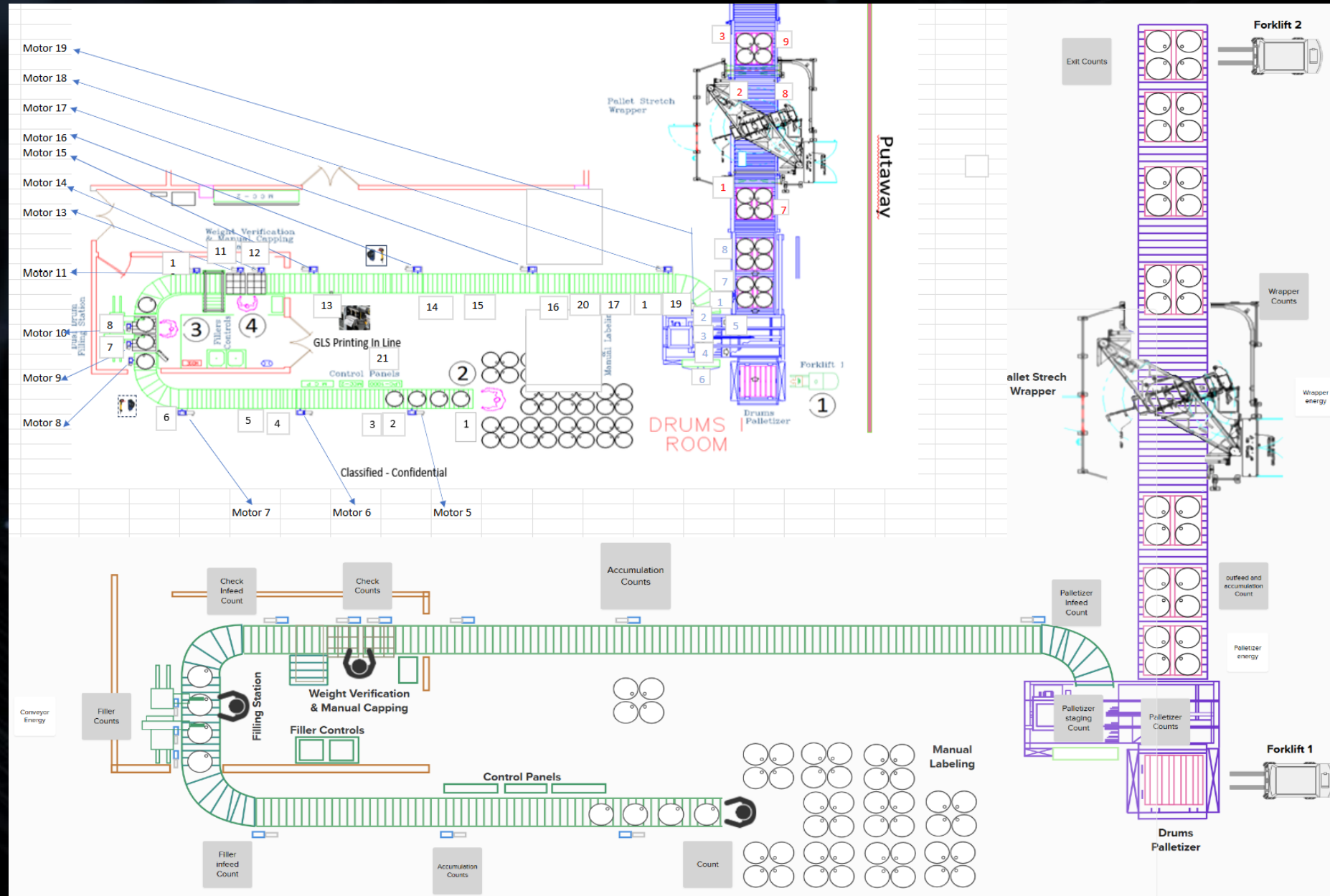


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Data & ML

Data Points and Prediction Cycle Time Sync

- **Coordination and adaptability:** Synced with Jean Louis for strategic alignment, build upon their work and introducing new concepts.
- **Cycle Time Prediction:** Foresee the end of cycle times and identify critical stations.
- **Enhanced Insights:** Additional sensors added to provide detailed analysis on areas of impact.
- **Proactive Alerts:** Receive advance warnings about potential bottlenecks to prevent stops.



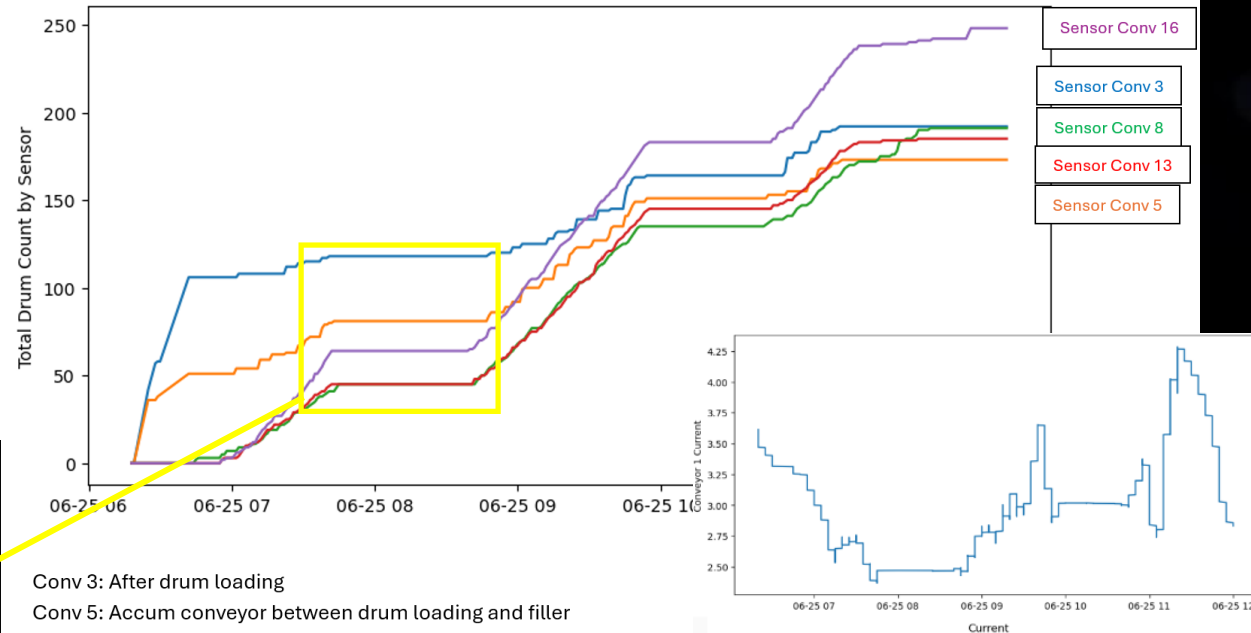
Identifying Data Trends Before Stop - Example

- **Monitor Performance:** Track each station's performance to identify operational patterns.
- **Predict Issues:** Use the data to foresee potential problems before they arise → prevent/reduce unplanned stops.
- **Maintain High OEE:** Ensure overall equipment effectiveness stays at optimal levels.

Downtime	Downtime	Start Time	End Time	Comments	Duration (Min.)	% of Total Downtime
	000100359878					
	2010	Jun 25, 2024 06:10:59 AM	Jun 25, 2024 06:53:38 AM	Preparar línea, conexión, densidad	-42.65	38.14%
	LUNCH A					
	000100359878					
	2020	Jun 25, 2024 10:44:44 AM	Jun 25, 2024 11:13:50 AM	lunch	-29.10	26.02%
	UNPL_STOP					
	PRODUCTION ERROR A					
	000100359878					
	2020	Jun 25, 2024 08:00:51 AM	Jun 25, 2024 08:40:55 AM	Conveyor	-40.07	35.83%

Process Order: 000100359878

Time ~ 06/25/2024 8:00 - 8:40 am



Conv 3: After drum loading

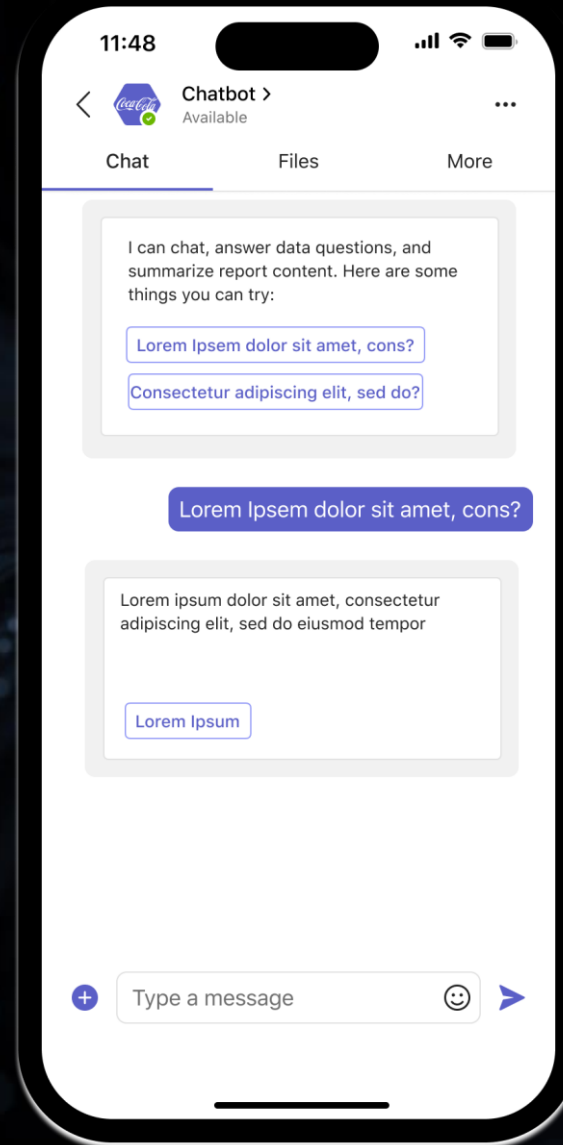
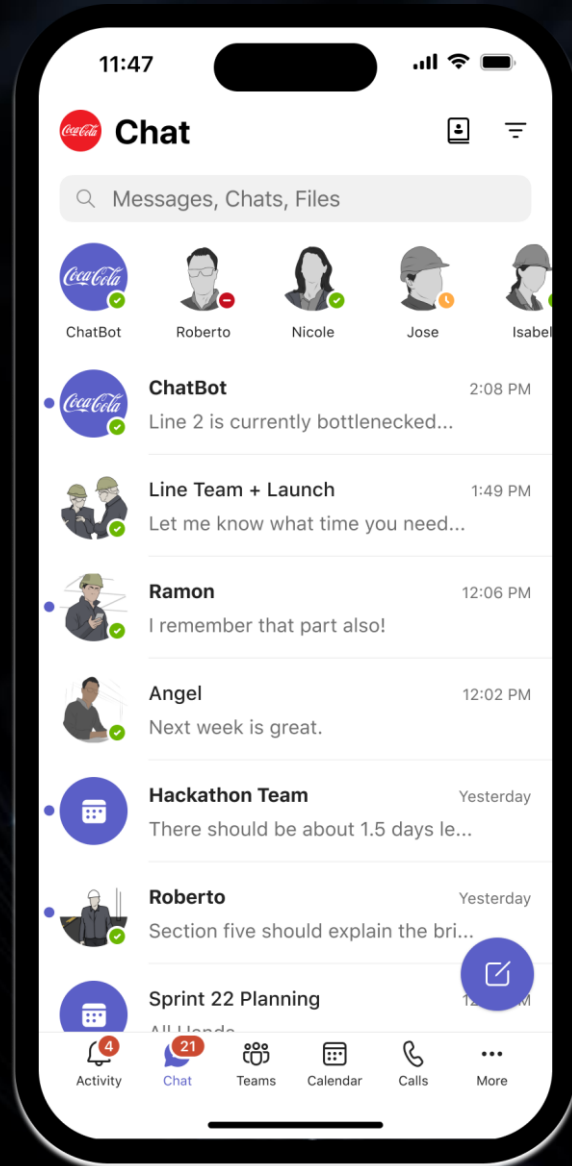
Conv 5: Accum conveyor between drum loading and filler

Conv 8: Filler 1B

Conv 13: Accum conveyor between checkweigher and pallet – part 1

Conv 16: Accum conveyor between checkweigher and pallet – part 2

Chatbot available through Teams



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Timeline

Current Plan & Next Steps

April

May

June / July / August

September

High-Level Scoping

- ✓ Site Visit & Introduction
- ✓ ISE Engagement Model
- Use Case Prioritization
- Offline data extract (inc. historical data for selected line(s))
- Sharing of CAD Files & Process Flow Diagrams
- Governance initiated
- **CWAA Sign-Off Required**

Workstream Start ups

- Environment Access & Set up
- PG Engagement, Technical Calls and intro to Copilot
- Coding resources identified
- Industrial AI Foundation Architecture
- End User Experience Design
- Backlog and Effort
- Project Description
- Game Plan
- Sprint Plan
- Initial Data Wrangling

Sprints

- Prototype Development
- Data Engineering & Modelling
- Use Case Proof of Value
- End Use Experience dev
- Steering
- Scale Planning

MVP complete & Value

- Engagement Planning
- Catcher Handover TCCC Internal, Microsoft and and/or Partner)

TCCC Required Resources

- IT and IOT Architect
- Process Engineer (Drones 1&2)
- Automation
- PM/PO

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- Line Supervisor
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- IT and IOT Architect
- Automation
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- PM/PO



Future Scale & Replicate

18 CPS Plants

1 Global
Operating
Model

3 Regional
Lighthouses

5 Pillars of
Transformation

 Lighthouse
Sites  Fast Follower
Sites



Organization
& Governance



Value-back
Approach



Agile Use Case
Delivery



Concurrent IT/OT
Deployment



Capability
Building

18 CPS Plants WorkCentre

	Dry Part (Auto)				Dry Part (Manual)				Large Liquid MFG				Liquid Filling (Auto)				Liquid Kitchen				Total
Automation Level	High	Low	Medium	None	High	Low	Medium	None	High	Low	Medium	None	High	Low	Medium	None	High	Low	Medium	None	
ABBP	4						1				4				5			2			16
Argentina	2	1	9			10	1	2	1	1				2	4			6		1	40
Ballina			1				1	1	3	3	15		7	2	4		1	12	3	1	54
Brazil	4		6			3	1								2			1		1	18
Chile			1				1				6	3			3	1		1	1		17
China			1			2		2		8	5	3		1	2					1	25
Cidra	1		1						2	1	3	3	7					3	2		23
Egypt			3			3	2			1				1				1			11
eSwatini	1		2			3				3			2		1			2			14
France			6		1	4		2			1			3	4			1			22
India			1			2	1	1		1	5			1	3				1		16
Indonesia											5										5
Japan		1	3	1		1		3			1	5		3	2	2		1		2	25
Korea			2			6		1	1		1										11
Liberia	2					1				2	1			2	3			10			21
Mexico	1		8			1		3		3	5			2	9	2		1			35
Pakistan	1					3			1		7		1	2	5			3			23
Singapore	2		3			4			1	5	3				4			2			24
Grand Total	18	2	47	1	1	43	8	15	9	28	62	14	17	19	51	5	1	46	7	6	400

Standard Architecture

ENTERPRISE

DMZ

SHOPFLOOR

SAP TEAM SCOPE

GLOBAL PMO ENSURE PROGRESS OF THE OVERALL PLAN

ANALYTICS SCOPE

POF MANUF SCOPE FOR GLOBAL ROLLOUT

IT/OT SCOPE FOR GLOBAL ROLLOUT

AUTOMATION SCOPE FOR GLOBAL ROLLOUT

Liquid Batch

Liquid Filling

Dry Filling

Individual Equipments PLCs

Classified - Confidential

```

graph LR
    A[Onsite Assessment] --> B[Align on hardware upgrade requirement]
    B --> C[Tender process]
    C --> D[CAPEX Approval & PO issuance]
    D --> E[Project execution]
    E --> F[System Go live & Hyper Care]
  
```

Site	System Integrator	Jan 24	Feb 24	Mar 24	Apr 24	May 24	Jun 24	Jul 24	Aug 24	Sep 24	Oct 24	Nov24	Dec 24	Q1 25
Liberia	Local SI	Build/test		Go live/hyper care										
Chile	Local SI	Build/test				Go live/hyper care								
ABBP	LTTS	EMR/MII to be rolled out by August				Scoping /PO	Build/test					Go live/hyper care		
CRI	Local SI													
Argentina	LTTS					Scoping /PO	Build/test			Go live/hyper care				
Mexico	LTTS					Scoping /PO	Build/test					Go live/hyper care		
Midi	TBD								Scoping /PO	Build/test		Phase 1 Go live/hyper care		
Bahrain	TBD	To focus on manual line connectivity												
Korea	Local SI	Build/test		Go live/hyper care										
Indonesia	Local SI	Go live/hyper care												
Shanghai	Local SI	Phase 2 Build/test					Go live/hyper care		Phase 3 Build/test			Go live/hyper care		
India	LTTS				Scoping /PO	Build/test		Phase 1 Go live/hyper care		Build/test			Phase 2 Go live/hyper care	
Pakistan	LTTS					Scoping /PO	Build/test					Go live/hyper care		
Singapore	TBD	1 line integrated with ignition in 2024 and full transition to ignition by Q2 2025												

FAQ

1. Definition of Plant Classification as - Complex, Medium, Small

- Lighthouse (Complex): Singapore, Ireland, Costa Rica, France (Coming up)
- Fast Follower (Not sure is consider medium): Puerto Rico, Mexico, ABBP, Brazil, China, Japan, eSwatini, Argentina, India (Pune), Egypt
- Small Plant: Korea, Indonesia, Pakistan, Chile, India (Bavla)

2. What KPIs are being reflected in the POC, Is this identification of bottleneck on bottling line ?

- OEE and SPC are part of the KPIs. 3D model and bottleneck prediction will be added by measuring the cycle time of each asset and the buffer in between each of them. The model is still WIP with Microsoft. We can share the UDT that we are already collecting for some plants and planning to extend to all the plants.

3. line Asset Ontology : Is it available for all plants.

- This is work in progress as well as the definition of the latest Data Model.

The background is a dark, textured surface with intricate, glowing patterns. These patterns consist of numerous thin, curved lines that flow across the frame, interspersed with small, bright dots or particles. The overall effect is reminiscent of a complex network or a dynamic, organic structure. A solid yellow horizontal bar runs along the bottom edge of the image.

Q&A