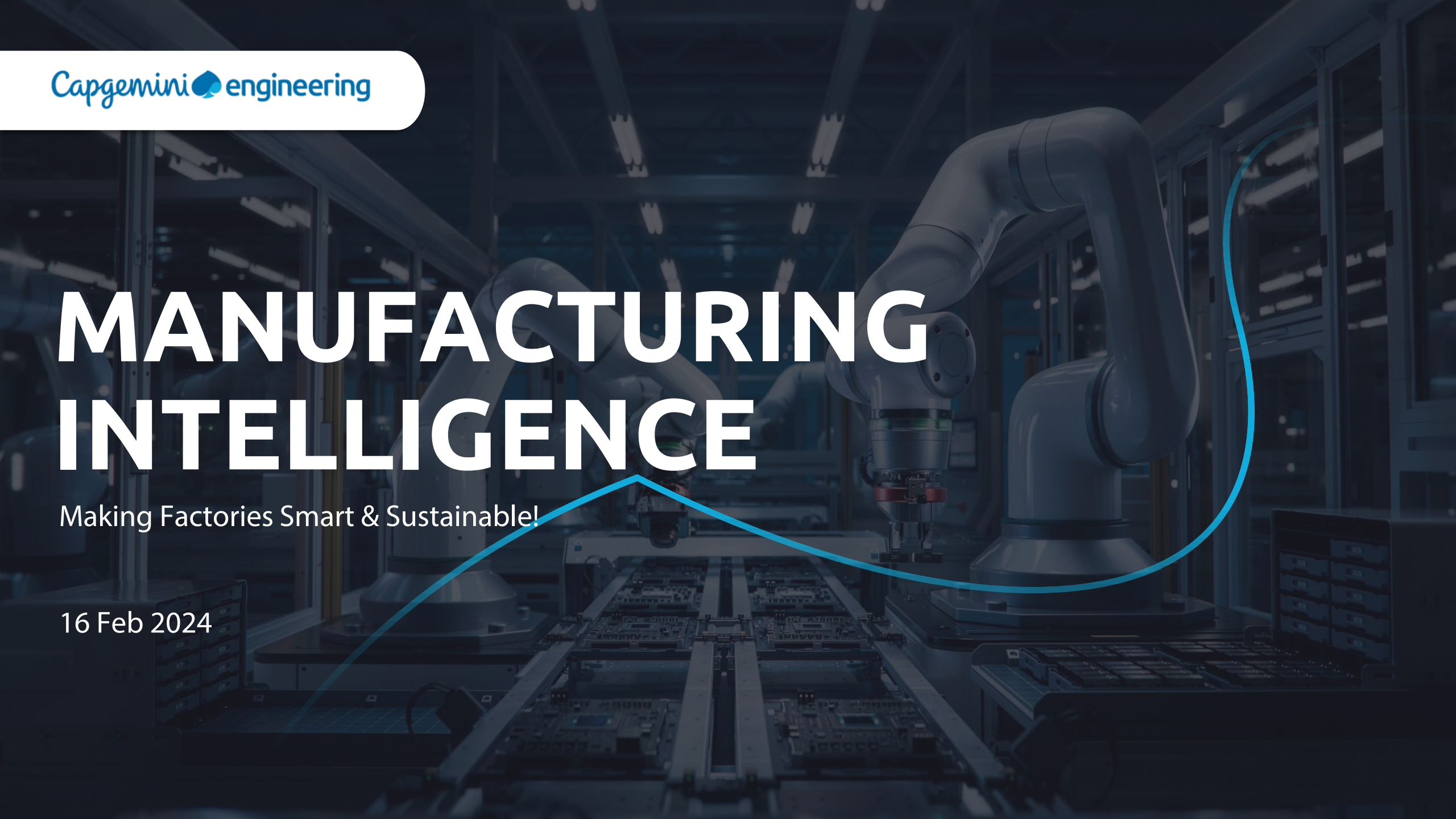
Capgemini engineering

MANUFACTURING INTELLIGENCE

Making Factories Smart & Sustainable!

16 Feb 2024



ABOUT ME

Mihir Punjabi

- AI/EI Solutions Director @ Capgemini Engineering, Mumbai
- Manufacturing Intelligence CoE

- Currently responsible for Analytics and AI solutions in Manufacturing
- Technology enthusiast with a passion to solve business driven challenges

- Email: mihir.punjabi@capgemini.com
- SogetiLabs expert http://labs.sogeti.com/experts/mihir -punjabi/
- LinkedIn: punjabimihir www.linkedin.com/in/punjabimihir

AGENDA

01 AI IN MANUFACTURING LIFECYCLE

02 WASTE REDUCTION JOURNEY

03 CHALLENGES AND APPROACH

04 GEN AI TEASER

05 Q & A

MANUFACTURING INTELLIGENCE
DATA, ANALYTICS AND AI CAN BOOST PERFORMANCE IN MANY AREAS

Preparation / Design

Supplier Quality Anticipation

Improve quality risks identification & collaboration with suppliers

Raw Material Mix Optimization

Steer raw material mix to optimize tradeoff between production cost, material availability and quality

Constraint Based Dynamic Scheduling

Optimize floor capacity utilization & ensure lean inventory

Golden Batch Recipe Generation

Recipe advisories and what-if scenarios basis historical data

Manufacturing / Assembly

Predictive Maintenance

Prescriptive Maintenance

Predict asset failure to better plan (& assist) maintenance

Real-time Alerting

Visualize production in real time and alert in case of deviation

Process Improvement / Control

Optimize process parameters to increase efficiency and quality

Predictive Quality

Reduce defects per batch/product resulting in waste reduction

Quality inspection

Defect Detection (Image Recognition)

Automate manual controls on product quality

Intelligent NC* Classification

Qualify and regroup similar non-conformities to support continuous improvement

Warehousing / Shipping

Inventory management

Optimize inventory to adequately meet demand JIT

Route Optimization

Optimizes shipping routes, reduces fuel use, ensures timely deliveries, boosting efficiency.

Problem solving

Assisted Root Cause Analysis

Identify weak signals leading to non-conformities

Smart recurrent NC* solving

*Suggest relevant remediation plans for recurrent NC**

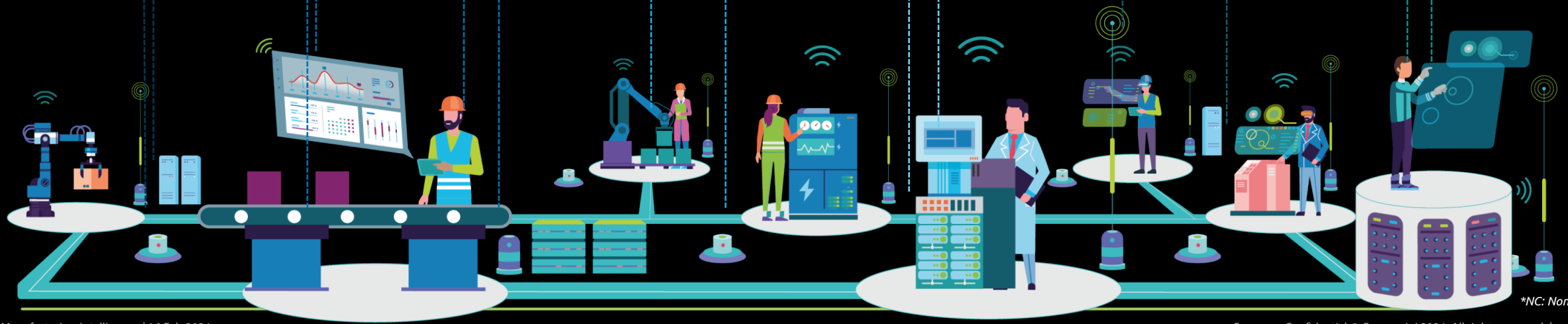
Monitoring

Plant Control Tower

Steer production and industrial flows in a centralized environment

Energy Mix Optimization

Optimize energy consumption of production assets



*NC: Non Conformity

MANUFACTURING OF ORAL NICOTINE POUCHES

Mixer

- Tobacco leaves
- Formulation

Storage

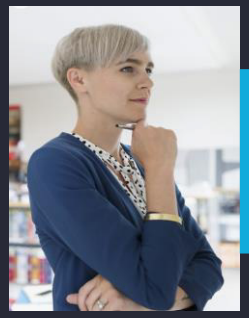
- Filler batches

Poucher

- Filler into Pouch & Seal

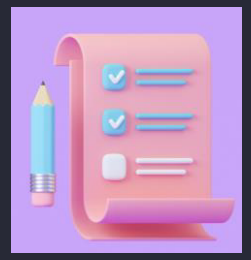
Canning, Packaging & Labelling

- Pouches into Can
- Label & seal
- Case/Carton



- Too many rejects from Poucher - leaky pouches
- Wastage at later stage or consumer complaints

SOLUTION KEY OUTCOMES & FRAMEWORK DEPLOYMENT

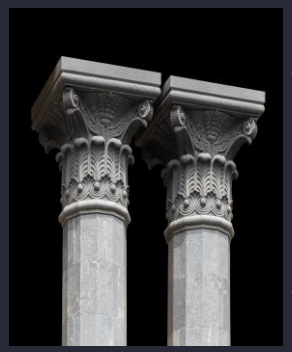


Reject reduction across SKUs; auto enhance over time with data

Identifying key influencing parameters & recommended values

Data that needs to be historized

Data gaps & inconsistencies



1. Monitoring Quality & influencing parameters @ line / SKU / Factory / equipment levels
2. Batches within & outside recommended ranges
3. Predicting rejects of each batch
4. Suggest workarounds for batches with high rejects
5. Top few historical batches with similar characteristics & their corresponding rejects
6. Monitoring & auto -upgrade of Prediction models & Recommended values (Golden batch recipe auto generation)

GOLDEN BATCH RECIPE AUTO GENERATION

Relevant Data sets

Algorithm

Minimize rejects with good coverage of data points

SKU	Recommended Range	Coverage %	Historical Reject %	Reject Reduction	F1 Score
Prod 1	"Temp" : [33, 47], "Pressure" : [53, 64]	35	7	2.0	0.56
Prod 2	"Temp" : [30, 49], "Pressure" : [51, 69]	70	8	1.0	0.78

Input data

Objectives

Constraints

Execute all permutations/combinations and output best possible option

"Worry About the Controllables!!"

PREDICTIVE QUALITY

- Predict accurately quality of goods being manufactured before it is manufactured
- Raise alerts well in time for operator to take corrective actions, as possible
- Point probable culprits and recommend corrective actions

FEW CHALLENGES RESOLVED BY DATA ANALYTICS/AI

Predictive Quality diapers hotmelt

Predictive Maintenance solutions for Mining conglomerate

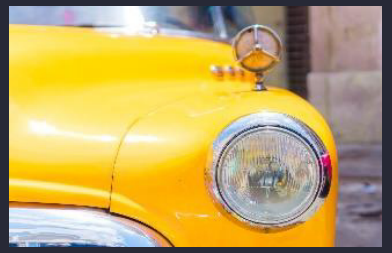
Predictive Maintenance program for aerostructures

Automotive Manufacturer AIV Forklift in warehouse

Smart Scheduling and constraint optimization

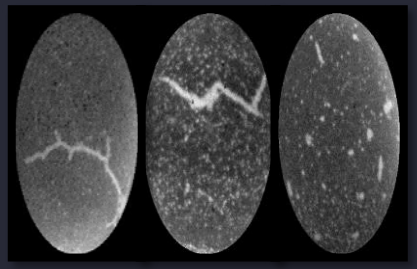
Worker safety - person detection, PPE kit detection

Monitoring of hazardous raw material delivery



Spare part quality inspection for automotive manufacturer

Quality inspection of Cosmetic bottles to prevent leaky packaging

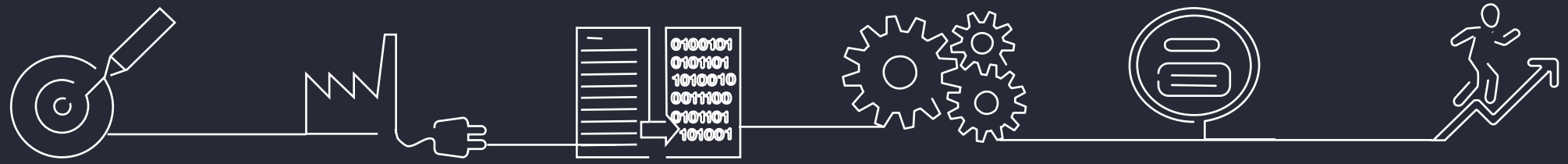


Egg sorter

LINKS FOR FEW SOLUTIONS

No	Solution	Link
1	Predictive Asset Maintenance	https://www.youtube.com/watch?v=WRIkKetqkRc
2	Egg Quality Inspection	https://www.youtube.com/watch?v=4r2XYRMUetY
3	Quality inspection of Cosmetic bottles to prevent leaky packaging	https://www.linkedin.com/posts/capgemini_success-story-lia-au-service-de-la-performance-ugcPost-7021827371896872960-rPHS?utm_source=share&utm_medium=member_desktop
4	Virtual Smart Factory	https://www.youtube.com/watch?v=NrQBMUZ7BJ8
5	Transforming industrial crane system automation at Schneider Electric with 5G	https://www.youtube.com/watch?v=1JlpyTx7Ns4
6	Intelligent Operations Platform / Factory of Future	▪ https://www.youtube.com/watch?v=s-AmVaN5dPM ▪ https://www.youtube.com/watch?v=z2IEl4ikSlQ&t=17s
7	Green Lean Digital Factory	https://www.youtube.com/watch?v=yNQqX2yFCJI

SUCCESSFUL IMPLEMENTATION OF ANALYTICS SOLUTIONS RELIES ON A WELL-THOUGHT-OUT APPROACH COMBINING DIFFERENT TYPES OF SKILLS



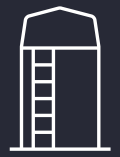
Business stakes & needed data	Connectivity	Architecture	Algorithms & Models	Dashboards & Analyses	Roll-out & Improvement
▪ Business stakeholder identification ▪ Use cases scoping ▪ Relevant data elicitation	▪ Ad hoc instrumentation ▪ Various PLCs ▪ SCADAs	▪ Data preparation ▪ Solution architecture design at site or enterprise level ▪ For PoV and scale - up	▪ Simple then advanced monitoring ▪ Predictive models development, training and validation	▪ Alerting dashboards ▪ Health monitoring	▪ Goals achievement ▪ Scale -up strategy definition ▪ Target / scale -up solution design, development and rollout

ITERATIONS ITERATIONS

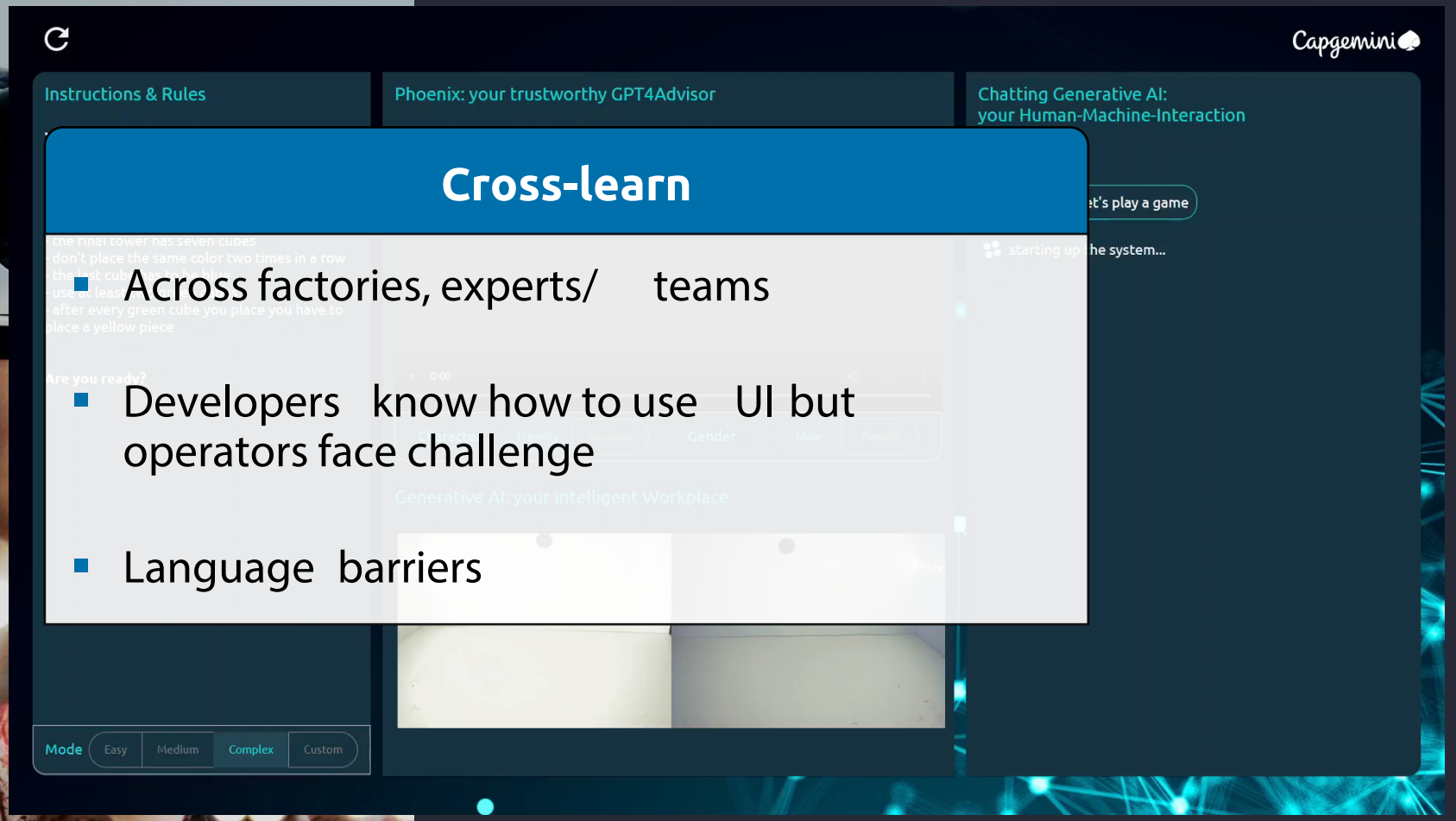
Business consulting | Connectivity | Data Science | Business consulting

Architecture | User interface design | Industrialization

KEY IMPLEMENTATION CHALLENGES THAT NEED TO BE CONSIDERED

	Lack of Digital Infrastructure	Lack of data to build Reliable AI	End-to-end integration	Cybersecurity
Challenges				
Solutions	Cloud or on -premise infrastructure	• Define a data -to-value strategy and roadmap. • Data engineering and model to ingest and store relevant data	Data platform to unlock data silos and ensure end -to-end integration and data traceability.	Multi -layered cybersecurity shield with user controls, data fortresses, risk watchtowers, and recovery plans.

PHOENIX, YOUR TRUSTWORTHY GPT4 ADVISOR – PART 3: SPECIFIC PRODUCT RULES



What can we learn & transfer to Intelligent Industry?

GET THE FUTURE YOU WANT