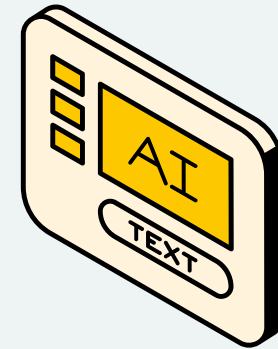


PHOEBUS AI SOLUTIONS

<https://phoebusai.com/>



# ML-BASED AUTOMATION & GEN AI-DRIVEN META AUTOMATION

**PRESENTED BY:**

**RAJESH KOVURI**

# AGENDA

- **Introduction**
- **Evolution of AI**
- **Challenges in EPICS-Based Processes**
- **Proposed ML and Gen AI Solutions**
- **Technical Implementation**
- **Pilot framework demonstration**
- **Security and Reliability**
- **Benefits and Future Prospects**
- **Questions and Answers**

# PHOEBUS AI SOLUTIONS

## What we do?

- **AI-Driven Conversational Solutions**
- **Intelligent AI Automation**
- **Digital Transformation**

We believe in a Customer centric approach and collaborative partnerships.

# EVOLUTION OF AI

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## 1950'S

### Birth of AI

The era when Alan Turing laid the groundwork for artificial intelligence with symbolic reasoning.

## 1980'S-1990'S

### Rise of Machine Learning

Data-driven algorithms like neural networks and SVMs revolutionized AI's learning capabilities.

## 2010'S

### Deep Learning Revolution

Advancements in GPUs and big data enabled breakthroughs in vision, NLP, and speech processing.

## 2020-2023

### Generative AI (Gen AI)

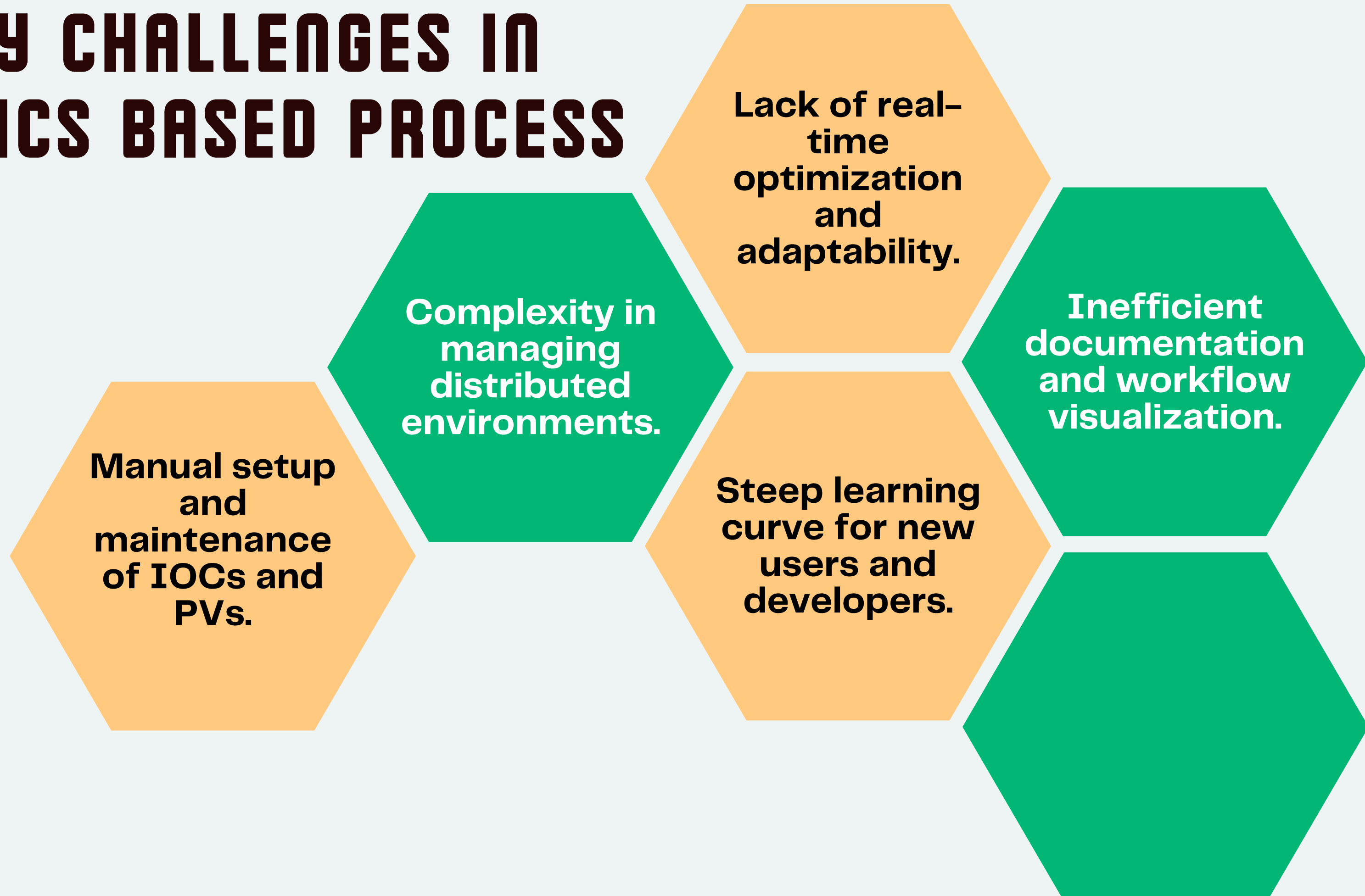
Generative models like GPT redefined AI's role in creativity and automation.

## 2024

### Large Action Models (LAM)

Real-time, meta-automation systems integrated AI-driven optimization into laboratory workflows.

# KEY CHALLENGES IN EPICS BASED PROCESS



# ENHANCING EPICS FOR EFFICIENT LABORATORY PROCESS AUTOMATION

## END-TO-END

Combining Machine Learning (ML) with Generative AI (Gen AI) to enable end-to-end automation of laboratory processes.

## TRAINING LAM SYSTEM

Large Action Model (LAM) system trained on user behavior to:

- Generate optimized control parameters.
- Create executable scripts (e.g., LabVIEW, MATLAB).

## CLOUD SANDBOX

Execute workflows on secure cloud sandboxes, spawning and terminating dynamically

# BEAMLIN OPTIMIZATION

A LAM trained on historical beamline data can predict control parameters (e.g., magnet currents, RF cavity settings) that maximize throughput and precision.

Simultaneously generates a LabVIEW script to automate the setup, saving significant time during calibration.

# PROPOSED ML AND GEN AI SOLUTIONS



## ML FOR CONTROL OPTIMIZATION

Train on historical user behavior to derive optimal parameters.



## GEN AI FOR CODE GENERATION

Automatically create control scripts (e.g., LabVIEW, Python)



## DYNAMIC WORKFLOW EXECUTION

Deploy workflows on secure, temporary cloud environments.



## SMART VISUALIZATION

AI-powered dashboards for real-time monitoring and control



# TECHNICAL IMPLEMENTATION

01

## TRAINING DATA

Historical PV logs, device configurations, and feedback.

02

## MODEL SELECTION

- Supervised ML for parameter prediction.
- Gen AI (Transformers) for script generation.

03

## INTEGRATION AND

## EXECUTION ENVIRONMENT

- Use EPICS Channel Access APIs to connect AI models to existing systems.
- Deploy workflows on cloud sandboxes for secure, isolated operation.

# PILOT DEMONSTRATION FRAMEWORK

Select a laboratory process for automation

Train Large Action Model on historical data

Generate control parameters and scripts  
using Gen AI

Deploy and execute workflow in a cloud  
sandbox.

Visualize results via AI-powered  
dashboards.

# SECURITY AND RELIABILITY

How do you ensure safety and reliability in AI-generated scripts and workflows?

- Accuracy of AI outputs
- Robustness of AI Models
- Redundancy and Fail-Safe Mechanisms
- System Uptime and Availability
- Human-in-the-Loop Framework

# BENEFITS AND FUTURE PROSPECTS

## **1.Automation Benefits:**

- Reduced manual intervention and errors.
- Faster setup and deployment.

## **2.Scalability:**

- Dynamic workflows adapt to different environments.

## **3.Future Applications:**

- Extending to broader EPICS-based processes.
- Incorporating real-time feedback loops

# QUESTIONS?

Let's explore how AI can redefine laboratory automation together.

<https://phoebusai.com/>

**Contact: 9866498855**

**Email: info@phoebusai.com**

**Hyderabad, Telangana**

# THANK YOU!