Process Improvement for Enterprise OT Asset & Lifecycle Management

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Abstract

This research project focused on improving Operational Technology (OT) asset management across manufacturing buildings by addressing gaps in asset visibility, lifecycle tracking, and cybersecurity resilience. The objective was to propose a centralized OT asset management system to replace segregated, manually maintained inventories. The DMAIC methodology was used to define the problem, measure the current process, analyze root causes, propose improvements, and establish controls for sustainability. Key tools included a project charter, SIPOC, Voice of the Customer, fishbone diagram, infrastructure architecture, and control plan. The analysis showed that manual inventory practices caused inaccurate data, inconsistent records, delayed vulnerability response, and increased operational risk. The proposed centralized system improves asset accuracy, standardization, real-time visibility, lifecycle management, and cybersecurity risk mitigation. Overall, the project supports a more reliable, proactive, and sustainable process for managing OT asset in manufacturing environments.

Introduction

Across manufacturing buildings, reliable asset information is necessary to support maintenance, troubleshooting, lifecycle decisions, and cybersecurity resilience. However, the current inventory process depends on fragmented and manually updated records, which can limit visibility and create inconsistencies between areas.

Background

Modern pharmaceutical manufacturing depends on Operational Technology (OT) assets to control, monitor, and support critical production processes. These assets include PLCs, HMIs, industrial computers, sensors, and other automation components that help maintain process stability, product quality, equipment reliability, and regulatory compliance. Literature related to process control and industrial operations emphasizes that accurate monitoring and control of manufacturing variables are essential to reduce process variation and support consistent production performance. In addition, standards such as ISA/IEC 62443 and NIST SP 800-82 highlight the importance of maintaining updated asset inventories and continuous monitoring to strengthen cybersecurity and operation resilience. However, common challenges arise when OT asset data is manually maintained, fragmented, or outdated. These conditions can create poor visibility, inconsistent records, delayed vulnerability response, lifecycle management gaps, and increased operational risk, supporting the need for a centralized OT asset management approach [1], [2], [3].

Problem

The OT asset management process relies on manual, segregated inventories, reducing visibility and accuracy across site buildings. This results in poor lifecycle control, slower response to cybersecurity risks, increased operational risk, and higher effort to maintain reliable records.

Methodology

The project followed the DMAIC methodology to guide the improvement process in a structured and data driven way. In the Define stage, the problem, scope, objective, stakeholders, and project metrics were established through a project charter,. In the Measure stage, the current OT asset management process was reviewed using SIPOC and Voice of the Customer tools to identify inputs, outputs, customers, and key needs. In the Analyze stage, a fishbone diagram was used to organized potential root causes affecting the current process. The Improve stage focused on developing the proposed centralized OT asset management approach, using Rockwell FactoryTalk Asset Centre infrastructure software, while the Control stage defined actions to sustain the improved process [4], [5].

Results and Discussion

During the Define stage, the project problem, objective, scope, stakeholders, and key metrics were established to guide the OT asset management improvement. As shown in Table 1 and Table 2, the Measure stage helped document the current process flow and capture customer needs related to asset visibility, data accuracy, standardization, and cybersecurity response. These findings confirmed that the current process depends heavily on manual updates and fragmented information sources, creating inconsistencies and delays when accurate asset data is needed.

Table 1: SIPOC

Suppliers	Inputs	Process	Outputs	Customers
IT / OT teams	Current asset inventory	Asset data collection	Consolidated inventory	Cybersecurity IT / OT Teams
Engineering	Asset information (Brand, model, firmware version)	Asset information confirmation	Accurate asset information	
Vendors	Technical specifications	Data standardization	Centralized visualization	Operations
Current Systems (CMMS, Excel)	Historical registers	Centralized system integration	Asset reports	QA / Compliance
Cybersecurity	Security requirements	Updates and monitoring	Vulnerabilities identifications	Management

Table 2: Voice of the Customer

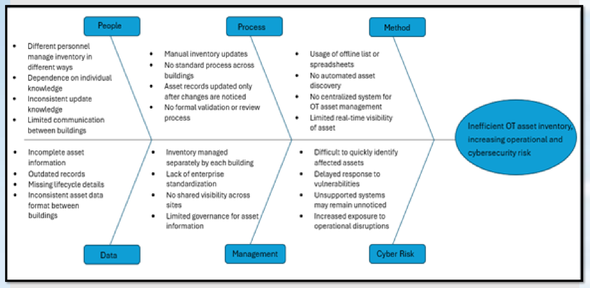
Voice of the Customer	Key Customer Issues	Customer need
IT/OT Temas	Asset lists are manual, incomplete, and the process is different by building	Access to accurate, current and complete OT asset information
	Existing records may be outdated or inaccurate	Reliable information for maintenance and system updates
	Each building manages inventory differently	Standardized process across all buildings
	Information is segregated by building	Enterprise-level visibility of OT asset
Engineering	Information is not centralized and takes time to find	Easy access to asset details for troubleshooting and support
Cybersecurity	Missing information slows mitigation actions	Faster assessment of vulnerable or unsupported assets
Current systems	Inventory creation requires physical checks and manual updates	Reduced manual effort and less time spent building inventories

The information collected during the Define and Measure stages was then used in the Analyze stage to identify the main causes contributing to the current process gaps. The analysis focused on understanding why OT asset information becomes outdated, difficult to access, or inconsistent across manufacturing buildings.

Results and Discussion

These causes are organized and presented in the Fishbone Diagram shown in Figure 1.

Figure 1: Fishbone Diagram



Based on the identify gaps, the Improve stage proposes a centralized enterprise OT asset management system to replace the fragmented manual inventories with a standardized and automated process. This improvement supports more accurate asset data, better lifecycle tracking, improved visibility across buildings, and faster cybersecurity resilience. In the Control stage, standard practices, defined responsibilities, monitoring activities, and periodic reviews are proposed to sustain the improvement over the time and keep asset information accurate and reliable. The proposed centralized solution and future process are presented in the Infrastructure Architecture Diagram in Figure 2 and the Future Asset Process Flow Diagram in Figure 3.

Figure 2: Infrastructure Architecture Diagram

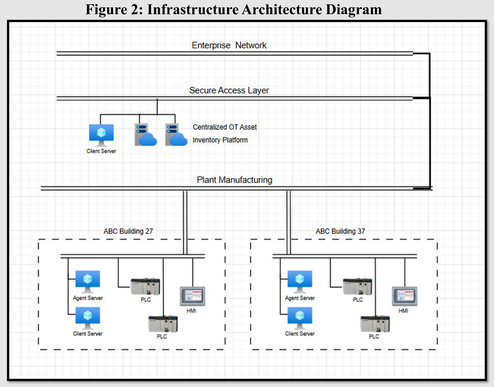


Figure 3: Future State OT Asset Management Process Flow Diagram

Conclusions

In the investigation process, several gaps were identified in the current process for managing OT asset inventory and lifecycle information. These gaps included lack of centralized information, manual effort to build and maintain inventories, limited enterprise level visibility, and inconsistencies across buildings. It was also identified that customers need accurate, complete and reliable OT asset information to support maintenance activities, system upgrades, troubleshooting, cybersecurity vulnerability management, and lifecycle decisions. The problem definition, identification of customer needs, and the analysis of current gaps were all supported through the application of the DMAIC methodology.

Based on these findings, a centralized system is proposed as the main improvement to standardize the process across all buildings, provide easier access to asset information and reduce manual inventory efforts. This solution would improve data accuracy, increase enterprise visibility, support faster decision making, and reduce operational and cybersecurity risks.

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