

Developing a Beta Version Tool Tracking System for Production and Operation Management in a Sugar Central Plant in Tarlac: A Case Study

SHAYE CAROLINE MANLUPIG¹, MICHAEL JOHN VILLAR²

^{1, 2} *Master of Engineering Management, Nueva Ecija University of Science and Technology*

Abstract - The sugar industry in the Philippines faces unique operational challenges due to its binary schedule of milling and repair seasons. For long-standing facilities like Central Azucarera de Tarlac (CAT), overreliance on manual inventory procedures has led to high inventory shrinkage caused by misplacement, damage, and lack of accountability regarding maintenance tools. This study details the development of a Beta Version Tool Tracking System designed to digitalize asset management and reduce recurrent procurement costs. The study followed a three-phase methodology which includes data gathering, designing the system architecture, and developing a beta version of the system before the initial testing. Preliminary results indicate that the system establishes a clear chain of custody, ensuring personnel accountability through digital records. By transitioning from manual tracking to a data-driven IT framework, CAT can significantly mitigate financial drain and improve operational efficiency during critical repair seasons.

Index Terms – Sugar Production management, Tool & System Tracking, Inventory Management, IT Based Monitoring System

I. INTRODUCTION

The sugar industry in the Philippines remains an essential contributor in the national economy. With annual production of approximately 2.2 metric tons, Philippines consistently ranks 17th to 18th largest sugar producers in the world. [1] Unlike other manufacturing industries who have year-round operations, sugar centrals operate on a binary schedule which is highly dependent on the sugar cane harvest. Generally, the operations of sugar central plants are divided into two – milling season and repair season. Milling season usually begins as early as October to March where there is sugarcane harvest. The rest of the year will then be dedicated to maintenance and repair season. [2] With this unique set-up, effective systems for maintenance and repair are essential to ensure continuous operations and profitability.

Accad et. al. developed an integrated inventory management and asset tracking system with user-centric computer kiosk interface which has significantly improved the department's overall performance and efficiency. [3] According to Meeran et. al., keeping track of tools is essential for smooth operations of plants as non-availability of tools leads to downtime. By digitalizing tool tracking systems, the plant can significantly improve its operations as well. [4]

The implementation of an IT-based tool tracking system will yield significant contributions to the plant's cost reduction. This will solve the problem of recurrent procurement of tools every repair season which has become a constant financial drain over the years. Moreover, the development of an IT-based tool tracking system will also be a foundation for the plant's digitalization of its asset management.

This paper discusses the development of a Beta Version Tool Tracking System for Production and Operation Management of a sugar central in Tarlac.

II. STATEMENT OF THE PROBLEM

Central Azucarera de Tarlac (CAT) was established in 1927 and is considered as one of the oldest sugar centrals operating in the Philippines and the lone sugar manufacturing plant in Central Luzon. [5] Given its longevity, CAT faces a problem caused by overreliance on manual operations systems and lack of digitalization in asset management. Upon reviewing its capital expenditure, there is a recurrent procurement of tools used for repair annually. The lack of tool tracking system leads to high inventory shrinkage which eventually forces the plant to constantly order tools essential for the repair season. High inventory shrinkage is mainly caused by damage, misplacement, and lack of accountability. Tools that

are worn out or beyond repair are being disposed of without being properly accounted. Misplacement is also a common occurrence where tools which are forgotten are simply considered lost. Since there is no system in place for tool monitoring and inventory, no personnel are held accountable for unreturned and lost tools. To solve this problem, a tool tracking system for production and operation management must be developed and implemented.

A study conducted by Gudagunti and Ali highlighted the importance of production planning tools in sugar industry. The use of such tools reduces the risks of downtime caused by non-value-added activities. [6] Andrada and Bischocho studied the effective facility layout and design of warehouse of sugar plants on the Philippines. This shows the impact of warehouse management and inventory systems on the profitability and efficient operations sugar plants. [7]

III. OBJECTIVES

The main objective is to develop and implement a tool tracking system for production and operation management for Central Azucarera de Tarlac to solve the existing problem caused by the lack of digitalization in asset management. The following are the specific objectives:

- a) To gather initial information on the current tool inventory and existing manual inventory procedures.
- b) To design the comprehensive database structure and user interface of the tool tracking system.
- c) To develop a Beta version of the tool tracking system to gather feedback for further improvements.

IV. METHODOLOGY

The study is divided into three phases:

Phase 1. Gathering information on the current tool inventory and existing manual inventory procedures.

To establish baseline information, a team from the Planning and Engineering department, which is the core team for this project, conducted a manual inventory of the tools for all the departments. The inventory record was then updated based on the actual

physical count of the tools. The variance between the physical count and the records also confirmed the problem of inventory shrinkage. Though time consuming, the manual inventory provided an accurate and updated inventory or master list of the tools which will then be the input for the tool tracking system that will be developed

Phase 2. Designing the comprehensive database structure and user interface of the tool tracking system.

In this phase, the system architecture was developed based from the user requirements established after the initial data gathering.

Phase 3: Developing a Beta version of the tool tracking system.

This phase involves thorough planning with the core team and the Management and Information System (MIS) department. The information needed for the database structure and user interface such as the master list of tools and all the functional requirements will be provided by the core team for the MIS department to start the actual coding and development of the Beta version of the tool tracking system.

Before the implementation, the functional Beta version will undergo rigorous User Acceptance Testing by the core team. This ensures that the system meets all the functional requirements and necessitates potential revisions to improve user experience. Once UAT is successful, the pilot implementation will be conducted within selected departments. User feedback will then be collected and analyzed for further improvement of the IT-based tool tracking system.

V. SYSTEM ARCHITECTURE

The Tool Tracking System for Production and Operation Management in Sugar Central consists of three components: Tool-to-Employee Registry, Tool Transactions, and Tool Status.

1. Tool-to-Employee Registry. This component includes the master list of tools and their assignment to specific personnel, establishing a clear chain of custody. The task was assigned to the department heads to ensure accuracy of this baseline data. The personnel will be tagged as “Owner” of the tools assigned to him/her.

2. Tool Transactions. This component is considered as the check in/out component of the system which shows the transactional movement of the tools. Borrowing of tools within the departments is occurring – so this provision was included in the tool transaction component. For example, an employee from Boiler department will borrow a tool from the Refinery department, and a digital transaction record will be available.

3. Tool Status. This component tracks the usability and availability of the tools. Each tool will be tagged as Active, Borrowed, Damaged, or Lost.

Active – Tools tagged as Active are physically present in the tool cabinet ready for use or are currently in use.

Borrowed – A tool tagged as borrowed is currently checked out to personnel other than its original owner, this will be reflected in the Tool Transactions component as well. A record of tools borrowed will be available which includes details such as the name of the borrower and their department, as well as the date it was borrowed.

Damaged – Before a tool is tagged as “Damaged”, it must undergo a thorough inspection by the Department head. Once tagged as damaged, it will be up for disposal process and will then be removed from the Active master list.

Lost – Tools that remained checked out or unreturned after a definite period despite all retrieval efforts, will automatically be tagged as “Lost” in the system. However, the personnel assigned as owner will be charged based on the salvage value of the item.

VI. CONCLUSION

The development of a comprehensive IT-based tool tracking system not only addressed the need for digitalization of asset management of CAT but also contributed greatly to the cost reduction measures of the plant. The components of the tool tracking system solve the issue of high inventory shrinkage and lack of user accountability by providing a clear chain of custody and availability of digital record of transactions and tool movements. While the impact of the tool tracking system lies on its subsequent implementation, the development of a Beta version

equips CAT to transition from manual inventory system to data-driven asset management.

REFERENCES

- [1] R. M. Briones, “Issues Paper on the Sugar Industry in the Philippines,” Philippine Competition Commission (PCC) Issues Paper No. 04, Quezon City, Philippines, 2020. [Online]. Available: https://www.phcc.gov.ph/storage/pdf-resources/1678085838_PCC-Issues-Paper-2020-04-Issues-Paper-on-the-Sugar-Industry-in-the-Philippines.pdf
- [2] N. Guadalquiver, “Sugar milling season for crop year 2025-2026 to start Oct. 1,” Philippine News Agency (PNA), Bacolod City, Philippines, Aug. 14, 2025. [Online]. Available: <https://www.pna.gov.ph/articles/1256567>
- [3] M. J. R. Accad, R. M. Bantayan, A. A. Calma Jr, K. E. Maquiñana, D. V. Tanael, and A. C. M. Maupay, "Integrated inventory management and asset tracking system with user-centric computer kiosk interface," *World J. Adv. Res. Rev.*, vol. 20, no. 3, pp. 270–276, Dec.2023, doi: 10.30574/wjarr.2023.20.3.2471
- [4] M. M. Tap, S. Meeran, and J. R. Hewit, "An active tool-tracking system for increased productivity," *Int. J. Prod. Res.*, vol. 38, no. 16, pp. 3889–3898, Nov. 2000, doi: 10.1080/00207540050176067.
- [5] Central Azucarera de Tarlac, Inc., "Central Azucarera de Tarlac," [Online]. Available: <https://luisitasugar.com/>. (Accessed: Dec. 16, 2025).
- [6] S. Gudagunti and A. Ali, "Implementation of Production Planning Tools in Sugar Industry," in *Proceedings of the International Conference on Industrial Engineering and Operations Management*, Bandung, Indonesia, March 6-8, 2018, pp. 3539–3548.
- [7] M. F. Andrada and M. R. Biscocho, "A Study on the Facility Layout and Design of Sugar Plants in the Philippines," in *Proceedings of the*

International Conference on Industrial
Engineering and Operations Management,
Bangkok, Thailand, March 5–7, 2019, pp. 1248–
1257.