Proceedings of the 2023 Winter Simulation Conference
C. G. Corlu, S. R. Hunter, H. Lam, B. S. Onggo, J. Shortle, and B. Biller, eds.

IMPROVING BUFFER STORAGE PERFORMANCE IN CERAMIC TILE INDUSTRY VIA SIMULATION

Marco Taccini

Department of Sciences and Methods for Engineering
University of Modena and Reggio Emilia
Via Giovanni Amendola, 2
Reggio Emilia, 42122, ITALY

ABSTRACT

This study aims at identifying the best strategy to temporarily store products within a buffer area in an Italian ceramic tile company. The storage policy is analyzed to maximize the storage capacity, facilitate operators' activities, and, consequently, improve the warehouse logistics performance. A discrete event simulation was conducted using Salabim, a Python based open-source software, in order to determine the best policy. We compare the performance of the current storage policy, based on technical production properties of products, and a newly proposed one, based on products' downstream destination. The results suggested that the proposed strategy significantly improves the performance of the buffer area management. The approach can be applied to different applications, contributing to the literature on simulation-based decision-making in material management. Furthermore, the study provides a functional case study showing the potential and achievable results of Salabim for modeling complex systems.

1 INTRODUCTION

Over the past decade, the global ceramic tile market has experienced significant expansion, with Italy emerging as a prominent contributor (ACIMAC Research Department 2022). This trend highlights the sector's importance and aligns with existing literature. Research in the ceramic industry has focused on various topics, including production methods, sustainability, and the application of decision support systems. However, this contribution addresses the noticeable gap in the utilization of Discrete Event Simulation within the ceramic tile sector.

A critical issue in ceramic tile production is the Lack of Homogeneity in the Product (Boza et al. 2014), influenced by factors such as clay composition, temperature, and humidity variability. This lack of homogeneity contradicts the demand for uniformity in ceramic tile orders, driven by the side-by-side installation of tiles. To address this, ceramic companies usually incorporate classification stages to optimize storage and retrieval processes.

2 PROBLEM DESCRIPTION AND SIMULATION

The study focuses on the buffer area between the production plant and the logistics department, where pallets of tiles are temporarily stored by automated guided vehicles and later moved by operators into warehouses. The buffer area is divided in columns, each one dedicated to a class of product defined by the storage policy. This study introduces a novel storage policy that classifies pallets by their final destinations instead of their commercial characteristics, as currently done by the company.

Salabim (van der Ham 2018), an open-source simulation software based on the Python language, was used to analyze and compare the devised policy with the current one using carefully selected indicators.

Simulations are based on real-world data, encompassing 30 days of manufacturing activities. For each day, the simulation was run 10 times due to the stochasticity of the problem. Furthermore, due to positive market trends in the ceramic sector, it was crucial for the company to assess the new policy's impact on various production scenarios: seven scenarios were simulated, gradually increasing production quantity.

3 EXPERIMENTAL RESULTS

The results indicated a statistical difference between the two policies for each scenario. Figure 1 presents four graphs, each one displaying the mean simulation results for a distinct performance indicator.

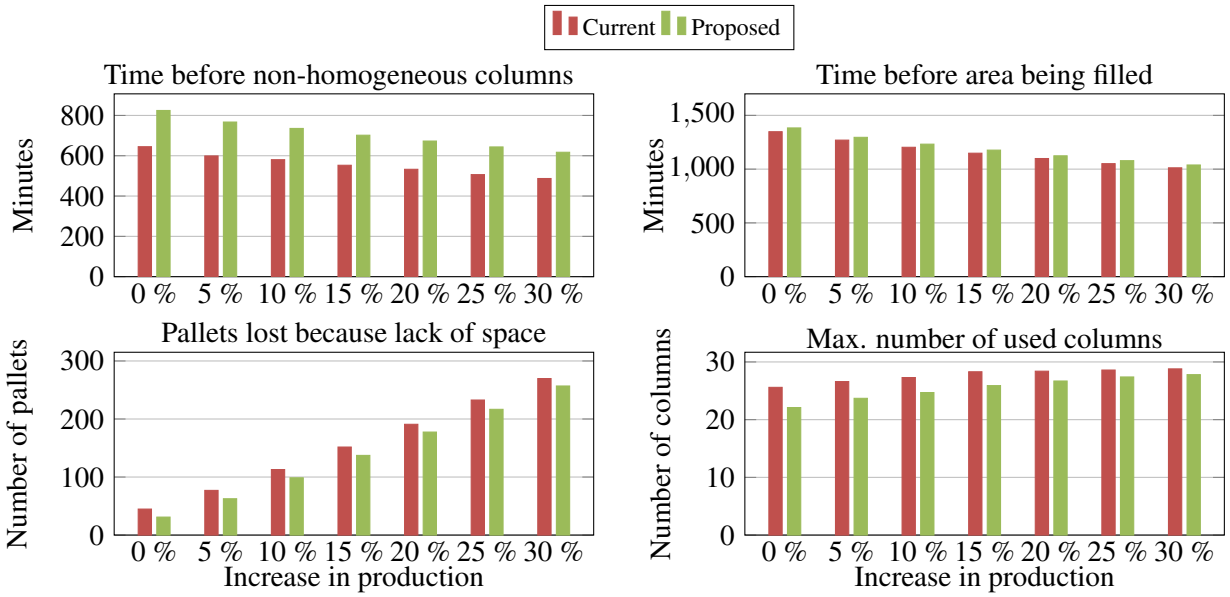

Figure 1: Mean simulation results for increasing percentages of production quantity.

The devised policy reduced the number of times in which non-homogeneous subgroups of tile pallets were stored in the same column of the buffer area, consequently accelerating operators' tasks. In addition, the proposed policy delayed the filling of the area, also preventing production stoppages that could negatively impact the company's profits. The third graph shows that the number of pallet lost because lack of space decreases with the new policy. Finally, it was also demonstrated that the devised policy reduces the number of required columns. This provided the company with the opportunity to either reduce the buffer area's space or increase production capacity. Furthermore, besides the measured results, pallet subdivisions based on downstream classification could further reduce the time required for subsequent operations. Therefore, the company could profit from both economic and flexibility advantages, providing strategic benefits to managerial decision-makers. For these reasons, the company decided to change their storage policy according to the results of the study.

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