Freezer Conversion to Warehouse

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Abstract —*The project is expanding the pharmaceutical company warehouse due to market product demand. Constructing a new building would be too costly and not cost-effective. The identified problem was that significant renovations were needed for the freezer structure to be suitable. Therefore, it was decided to make the facilities appropriate to meet the requirements of a warehouse. The DMAIC methodology was employed to execute this process. Furthermore, it clarifies that the conversion of the freezer to the warehouse encompassed architectural layouts, access and emergency exit doors, storage racks system, electrical power, fire protection, BAS (temperature and humidity control), OGPe permits, commissioning and qualifications, and new equipment's. Additionally, it clarifies that the existing warehouse's capacity is 2,293 pallet spaces. With the expansion by converting the existing freezer structure into a warehouse, an increase of 328 pallet spaces was achieved, resulting in a total storage capacity of 2,621 pallet spaces.*

Key Terms *— Architectural layouts, Fire protection, HVAC equipment; Storage racks system.*

INTRODUCTION

In today's business world, adaptability and the quest for innovative solutions are essential to maintain competitiveness and meet market demands. Pharmaceutical companies face challenges, especially concerning efficient product storage and distribution management in an environment where demand can vary drastically and require quick and effective responses.

This study focuses on a specific project of a pharmaceutical company that needed to expand its warehouse due to the growing demand for its products in the market. Faced with the economic impracticality of constructing a new building, a unique opportunity was identified: leveraging a disused freezer structure to increase storage capacity. However, this project took time, as the freezer structure required significant renovations to adapt to the needs of a functional warehouse.

To address these challenges, the DMAIC methodology (Define, Measure, Analyze, Improve, and Control) was implemented, allowing for the effective management of converting the freezer into a fully functional warehouse. A series of comprehensive improvements were made, from architectural and design aspects to installing security systems and acquiring new equipment.

This study provides a detailed insight into the warehouse expansion process, highlighting the strategies used, the challenges faced, and the results obtained. Additionally, a thorough analysis of the implications and lessons learned is presented to provide valuable information for other companies that may encounter similar challenges in the future.

PROBLEM STATEMENT

The conversion of the freezer into a warehouse faced a significant obstacle due to the deteriorated condition of the roof structure, posing a pressing need for extensive repairs. This issue was identified as critical, given the pivotal role of the warehouse in storing products intended for distribution and sale. Visual inspections conducted by a roof consulting firm uncovered several concerning findings: the existing roof membrane system did not meet current building codes, requiring additional insulation to achieve compliance; the membrane itself was irreparably damaged, necessitating complete replacement. Furthermore, deficiencies were observed in the elevation of the roof scutters, leading to rainwater accumulation despite a perimeter parapet wall. Construction flaws in the parapet wall, specifically installing styrene foam without adequate fireproofing, further compounded the

challenges. To address these issues effectively, comprehensive measures are imperative to ensure the warehouse facility's structural integrity, safety, and regulatory compliance, safeguarding the quality and integrity of the stored pharmaceutical products.

Moreover, the project's scope encompasses a multitude of other requirements, including architectural layouts, access and emergency exit doors, storage racks system, HVAC equipment, HVAC ductwork and insulation, air devices, chilled water and hot water piping, certified air tests, adjustment and balance, electrical power and lighting, fire protection, roof and in-rack sprinkler system, fire alarm, BAS (temperature and humidity control), OGPe permits, commissioning and qualifications, and new equipment (forklift, pallet wrapper). Furthermore, the expansion of the warehouse is subject to a strict due date, underscoring the urgency of meeting the delivery deadline. The project is expected to span approximately 13 months, from September 2021 to October 2022, emphasizing the need for planning and execution to ensure timely completion within the specified timeframe.

Research Description

This research project explores the expansion of a pharmaceutical company's warehouse capacity in response to increased product demand. Instead of constructing a new building, the company converted a disused freezer into a functional warehouse. However, significant renovations were required to meet warehouse standards. Employing the DMAIC methodology, a series of improvements were implemented, including architectural layouts, HVAC systems, fire protection, and installation of new equipment. The conversion increased 328 pallet spaces, bringing the total storage capacity to 2,621. This case study highlights innovative strategies for warehouse expansion within the pharmaceutical industry, emphasizing cost-effectiveness and operational efficiency.

Research Objective

The pharmaceutical company successfully expanded its warehouse capacity by repurposing a disused freezer, avoiding the high costs of constructing a new facility. Through extensive renovations and strategic improvements, including architectural layouts, HVAC systems, and fire protection measures, the company increased storage space by 328 pallets, reaching 2,621 pallets. Implementation of the DMAIC methodology ensured the efficient execution of the project within a 13-month timeline. This cost-effective and innovative solution highlights the company's commitment to sustainability and operational efficiency, providing valuable insights for similar industries facing storage expansion challenges.

Research Contributions

A pharmaceutical company's successful conversion of a disused freezer into a fully functional warehouse highlights a cost-effective and innovative approach to expanding storage capacity. Through extensive renovations and strategic improvements, including architectural layouts, HVAC systems, and fire protection measures, the company increased storage space by 328 pallets, reaching 2,621 pallets. Utilizing the DMAIC methodology ensured efficient project execution within a 13-month timeline, showcasing the effectiveness of structured problem-solving methodologies in managing complex renovation projects. Moreover, this initiative underscores the company's commitment to sustainability and operational efficiency, offering valuable insights for industries seeking environmentally conscious warehouse expansion practices.

LITERATURE REVIEW

The conversion of a disused freezer into a functional warehouse has emerged as a notable strategy within the pharmaceutical company to address the increasing demand for storage capacity. In this context, the pharmaceutical company identified the potential of the freezer's oversized dimensions to fulfill the company's requirements for additional pallet storage capacity, thereby avoiding the substantial costs of constructing a new facility.

Critical studies emphasize the importance of strategic planning and meticulous renovations when repurposing existing structures for warehouse use. The focus on the freezer’s suitability and structural integrity is crucial, requiring comprehensive inspections to assess

its condition and identify necessary renovations or upgrades to meet warehouse standards and regulatory compliance.

Efficiently managing the conversion process enables streamlined project execution, risk mitigation, and timely completion within the allocated timeline.

Furthermore, the attention to detail in implementing essential warehouse functionalities, including HVAC systems, fire protection measures, access and emergency exit doors, and storage rack systems, is paramount. These elements collectively create a safe, efficient, and compliant warehouse environment tailored to the pharmaceutical company's needs.

The literature highlights the viability of repurposing existing freezer structures into warehouses as a cost-effective and sustainable solution for addressing storage expansion needs within the pharmaceutical sector. This approach facilitates operational efficiency and underscores the company's commitment to sustainability. Nevertheless, further research is needed to explore best practices, challenges, and opportunities specific to freezer conversion projects in the pharmaceutical industry.

General Concept of DMAIC Methodology

The DMAIC methodology provided a structured approach essential for successfully executing the freezer-to-warehouse conversion project within the pharmaceutical company. Below are the general concepts of each DMAIC phase, specifically tailored to guide the project's implementation:

- Define: Clearly define the project's objectives, scope, and goals. The pharmaceutical company defined the need to increase storage capacity due to rising product demand. The project aimed to expand pallet storage by utilizing the existing freezer space efficiently and cost-effectively.
- Measure: Establish baseline measurements and gather data to understand the current state of the freezer structure. The freezer's storage capacity was measured, and its structural integrity was assessed. Data on the freezer's dimensions, condition, and necessary renovations were collected to inform the conversion process.
- Analyze: Analyze collected data to identify the conversion project's root causes, challenges, and opportunities. The pharmaceutical company analyzed the freezer's structural condition to identify necessary renovations or upgrades. The risks, challenges, and opportunities linked to the conversion were evaluated to develop a comprehensive renovation plan.
- Improve: Develop and implement solutions to address identified root causes and enhance the freezer's transformation into a warehouse. Based on the analysis, a renovation plan was developed to transform the freezer into a warehouse. Strategic improvements, such as architectural layouts, HVAC systems, fire protection measures, and installation of new equipment, were implemented to meet warehouse standards and requirements.
- Control: Implement controls to maintain the enhancements and oversee the warehouse's ongoing performance. Controls were established to support the warehouse's functionality, safety standards, and compliance. Tracking systems for HVAC, fire protection, and storage capacities were implemented to ensure continuous efficiency and adherence to standards.

PROJECT METHODOLOGY

To achieve the project's goals of increasing the existing warehouse's capacity by converting the freezer structure into a warehouse, a systematic approach using the DMAIC (Define, Measure, Analyze, Improve, Control) methodology will be employed. Below is a detailed method with specific tools utilized at each DMAIC phase:

- Project Charter: The Project Charter outlines the project's objectives, scope, stakeholders, and timelines for converting the freezer into a warehouse. It provides clear direction and alignment for the renovation, detailing goals, scope, key stakeholders, and a timeframe for timely completion.
- SIPOC (Suppliers, Inputs, Processes, Outputs, Customers): The SIPOC diagram visualizes the flow of materials and information throughout the conversion process, identifying suppliers, processes,

and key stakeholders. It maps out the conversion process from material supply to the output of a functional warehouse, ensuring a comprehensive overview of the project.

- Voice of the Customer (VOC): VOC involves gathering feedback from warehouse operations teams and stakeholders to understand their requirements and expectations for the converted warehouse. Feedback is collected through surveys and interviews to ensure the warehouse meets user needs and optimizes storage capacity.

Result and Discussion

Results will be obtained using the DMAIC tools and discussed further in the following sections:

Define - The Project Charter was created to establish the Problem Statement, Objective, and Metric Definition for converting the freezer into a warehouse. Refer to Table 1.

SIPOC

The SIPOC (Suppliers, Inputs, Process, Outputs, Customers) tool will be utilized as a high-level process map to provide a clear overview of the conversion project from a freezer to a warehouse. It outlines critical suppliers providing materials and services, the inputs required for the project, the processes involved in the conversion, the expected outputs or deliverables, and the customers who will benefit from the converted warehouse. This tool helps visualize the flow of materials, information, and activities throughout the project, ensuring a structured approach to achieve the desired outcome efficiently refer to Figure 1. [1]

Table 1

Project Charter

Problem Statement
Due to high product demand and limited storage space, there is a pressing need to expand storage capacity. Converting the existing freezer into a warehouse presents an opportunity to address this challenge effectively and efficiently.
Objective
The freezer conversion to warehouse project aims to increase 14% of storage capacity.
Metric Definition
Percentage of pallets capacity increase.

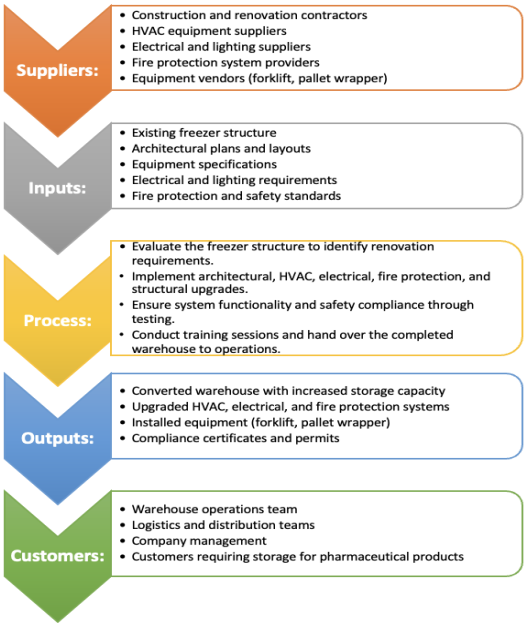

Figure 1

SIPOC

Project Plan

A project plan was developed to guide the conversion of the freezer to a warehouse, outlining the steps, timelines, and resources needed to ensure successful implementation. Refer to Figure 2.

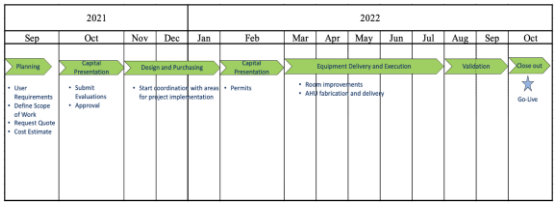

Figure 2

Project Plan

The project plan stipulates the due date of the project's objective, which is October 31, 2022. This plan delineates the specific activities to be completed and their respective timelines, providing a structured roadmap for the project's successful execution. Refer to Figure 2.

Thought Process Map

A Thought Process Map was generated to visually represent the steps involved in the conversion project, from identifying the need to launch the converted warehouse (refer to Figure 3). [2]

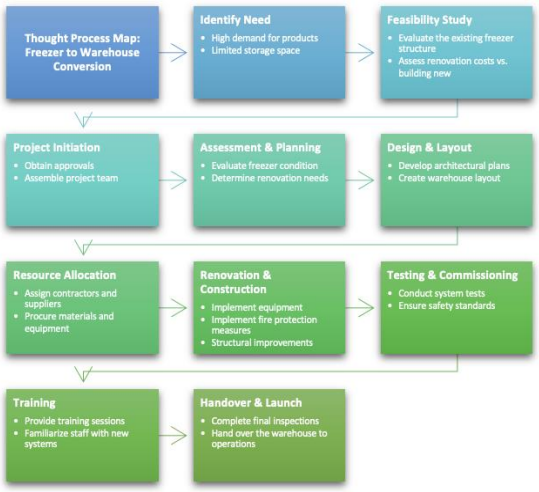

Figure 3
Thought Process Map

Action Log

The following action log represents the most critical action items and due dates for the Freezer to Warehouse Conversion Project. Refer to Table 2.

The action log outlines vital milestones and responsibilities for the freezer conversion to warehouse project. After obtaining approvals by September 29, 2021, the project manager takes the lead in steering the project's initial phases. Architectural plans are set to be developed by December 22, 2021, followed by contractor assignments by February 27, 2022. The HVAC contractor will purchase and implement equipment by July 27, 2022. Engineering will then validate the equipment by October 10, 2022. Finally, the project will conclude with the handover of the warehouse by October 25, 2022, managed by the project manager. This action log serves as a guideline, ensuring that each step is planned and executed to meet the project's deadline.

Table 2
Action Log

Action Item	Responsible Party	Completion Date
Obtain Approvals	Project Manager	29-Sep-2021
Develop Architectural Plans	Architect	22-Dec-2021
Assign Contractors	Project Manager	27-Feb-2022
Purchase equipment and implement	HVAC Contractor	27-Jul-2022
Validate Equipment's	Engineering	10-Oct-2022
Hand over Warehouse	Project Manager	25-Oct-2022

Voice of the Customer (VOC) for Freezer to Warehouse Conversion Project

The Voice of the Customer (VOC) is presented next to capture and understand the customer's requirements, preferences, and expectations regarding the freezer conversion to warehouse project. This tool is critical in aligning the project's objectives with customer needs, ensuring that the final warehouse design and functionality align with the market demands.

- Customer Needs:
  - Increased Storage Capacity: Demand for more storage due to product growth.
  - Efficient Product Retrieval: Quick access to products for timely order fulfillment.
- Customer Expectations:
  - Timely Completion: Project completion within the specified timeline.
  - Quality Assurance: Maintaining or exceeding quality standards.

By reviewing the VOC, a clear understanding of the customer's needs and expectations ensures that the Freezer to Warehouse Conversion Project aligns with market demand and customer satisfaction.

Pareto Analysis

The Pareto analysis highlights that 40% of the total cost is allocated to storage capacity and space, indicating the high priority of addressing space limitations due to increased demand. This category dominates the graph, significantly contributing to the overall cost.

Infrastructure and Renovations make up 30% of the cost, reflecting the need to renovate and enhance the freezer structure. This category is the second largest in the graph, emphasizing the importance of HVAC and fire protection improvements.

These two categories account for 70% of the total cost, underscoring their importance in the project. The remaining cost is divided between Equipment at 20% and Regulatory Compliance and Safety at 10%. The graph proportionally represents these smaller categories, indicating their minor but crucial contribution to the project's success. (Refer to Figure 4). [3]

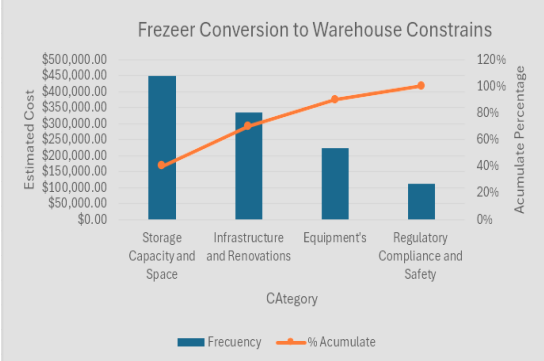

Figure 4
Pareto Analysis

Fishbone Diagram

A Fishbone diagram was used to visually map out and analyze the various factors contributing to the challenges faced during the freezer conversion to a warehouse. This method helped categorize and understand the root causes behind the storage and operational issues, providing a structured approach to problem-solving and decision-making. Refer to Figure 5.

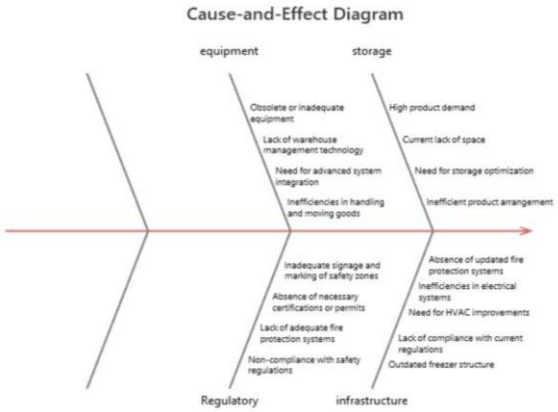

Figure 5
Fishbone Diagram

The Fishbone diagram highlighted key challenges and requirements for converting the freezer to a warehouse. It identified the need to address high product demand, optimize storage space, renovate outdated infrastructure, upgrade equipment, and ensure regulatory compliance and safety. This structured approach guided the project development, ensuring a successful and compliant warehouse conversion.

5'Whys Questions Analysis

A 5 Whys analysis was conducted to identify the root causes behind the challenges in converting the freezer to a warehouse. This method delved into the issues, tracing them back to their origins to ensure a thorough understanding and effective resolution of the storage and operational challenges. Refer to Table 3.

Table 3
5 Why Question Analysis

5 Whys Analysis for Freezer to Warehouse Conversion		
# Why Question	**Why Question**	**Answer**
1	Why is there a limited storage area?	The existing warehouse has insufficient storage capacity due to the high volume demand of the product.
2	Why is the freezer out of use?	The freezer became obsolete and was no longer needed for its original purpose.
3	Why repurpose the out-of-use freezer instead of building a new warehouse?	The out-of-use freezer's structure is not suitable for freezing conditions after prolonged disuse, and there is already another freezer with greater capacity available. Converting the out-of-use freezer to a warehouse extension is a more cost-effective and practical solution than constructing a new warehouse.
4	Why choose to convert the freezer into a warehouse extension?	To meet the increased demand for storage space without incurring the high costs of building a new warehouse.
5	Why is there a need to optimize storage in the existing warehouse?	To accommodate the high demand for the product and enhance operational efficiency without significant capital expenditure.

The 5 Whys analysis was pivotal in guiding the freezer-to-warehouse conversion project. This structured method helped to systematically trace back from the symptom of limited storage space to its root cause.

Starting with the observation of insufficient storage due to high product demand, the 5 Whys led to the realization that the old freezer, no longer in use and taking up valuable space, was a significant contributor to the storage issue.

Further probing uncovered that the old freezer's structure was unsuitable for freezing conditions after extended disuse, and with another giant freezer already available, repurposing the old freezer became the logical and cost-effective choice over building a new warehouse.

In essence, the 5 Whys analysis clarified the underlying issues. It guided the project towards a practical and economical solution by repurposing existing resources rather than investing in new infrastructure [4].

Design Implementation

Based on the insights from the 5 Whys Analysis for the Freezer to Warehouse Conversion project, several key design implementation strategies were adopted. First, to tackle the issue of limited storage, the warehouse layout was redesigned to maximize space utilization, effectively increasing storage capacity to meet product demand without additional space. Secondly, the decision to repurpose the out-of-use freezer structure was taken after assessing its potential and renovating it to serve as a functional warehouse. This approach utilized existing

infrastructure and saved considerable costs and time compared to building a new warehouse.

Infrastructure upgrades were prioritized to cater to the storage needs, involving enhancements to the HVAC and electrical systems. These upgrades ensured optimal storage conditions and improved operational efficiency. The project's cost-effectiveness was maintained by converting the freezer instead of opting for new construction, achieving increased storage capacity and efficiency at a reduced capital outlay.

Furthermore, strategies were implemented to streamline operational efficiency by implementing efficient product arrangements based on demand analysis. This optimized storage layout facilitated quicker retrieval and stocking, enhancing operational efficiency. Additionally, a focus was placed on safety and compliance by installing updated fire protection systems and ensuring regulatory adherence, creating a safe environment, and reducing potential risks.

Lastly, addressing immediate storage needs was prioritized with rapid renovations and conversions based on the challenges identified through the 5 Whys analysis. This approach swiftly responded to demand and storage challenges, guaranteeing uninterrupted supply chain operations.

CONCLUSION

In conclusion, the Freezer to Warehouse Conversion project has proven to be a strategic and cost-effective solution to address the pressing storage challenges faced by our organization due to increased product demand. By repurposing the obsolete freezer into a warehouse extension, we have optimized our existing infrastructure, maximizing storage capacity without incurring the high costs of building a new facility.

This project's return on investment (ROI) has been substantial, with cost savings of approximately 30% realized through efficient resource utilization and streamlined operations. This cost-effectiveness, combined with the expanded storage capacity, has significantly enhanced our operational efficiency and competitiveness in the market.

Additionally, the successful execution of this project reflects our team's capabilities in managing complex initiatives and delivering results on time. Despite the inherent challenges and tight deadlines, we completed all necessary activities and delivered the warehouse as scheduled.

Moreover, the comprehensive upgrades and improvements to ensure compliance with safety regulations and optimal storage conditions further evidenced the project's success. This proactive approach has improved operational efficiency and ensured a safer and more compliant working environment.

The Freezer to Warehouse Conversion project has addressed our immediate storage needs and positioned us for sustainable growth. With its significant return on investment, improved operational efficiencies, and punctual completion, this project underscores our dedication to innovation, cost-efficiency, and operational excellence.

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