Increase Packaging Line Capacity Using an Automated Packaging Machine

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Abstract *– The pharmaceutical industry, particularly in animal health, faces challenges in optimizing production processes to improve efficiency and reduce costs while maintaining product quality and safety standards. This study focuses on addressing a bottleneck in the production line of a local pharmaceutical company, specifically in the manual secondary packaging stage. Four operators are employed to pack blisters into sleeves, leading to inefficiencies, higher labor costs, and potential errors. To overcome this challenge, the company aims to integrate the BIB-BOB machine, which offers a significantly higher output rate of 150 blisters per minute (bpm). However, before implementing this automation solution, a comprehensive cost analysis is imperative to evaluate its financial viability, considering factors such as initial investment, operational costs, labor savings, and productivity gains. The objective is to optimize the packing line to enhance efficiency, reduce costs, and improve overall profitability, all while upholding the quality and safety standards of the packaged medicines.*

Key terms – *Automation, Efficiency, ROI and Pharmaceutical packaging process.*

INTRODUCTION

The local pharmaceutical company faces a bottleneck in its production line due to the manual secondary packaging stage, where four operators are employed to pack blisters into sleeves. This manual process not only hampers production efficiency but also incurs higher labor costs and introduces the risk of errors. To address this challenge, the company aims to integrate the BIB-BOB machine, boasting 150 blisters per minute (bpm) output rate, which could double the current packing speed. However, before proceeding with this automation solution, a comprehensive cost analysis is necessary to evaluate its financial viability, considering factors such as initial investment, operational costs, labor savings, and productivity gains. The objective is to optimize the packing line to improve efficiency, reduce costs, and enhance overall profitability while maintaining the quality and safety standards of the packaged medicines.

PROBLEM STATEMENT

The local pharmaceutical company faces a bottleneck in its production line due to the manual secondary packaging stage, where four operators are employed to pack blisters into sleeves. This manual process not only hampers production efficiency but also incurs higher labor costs and introduces the risk of errors. To address this challenge, the company aims to integrate the BIB-BOB machine, boasting 150 blisters per minute (bpm) output rate, which could double the current packing speed. However, before proceeding with this automation solution, a comprehensive cost analysis is necessary to evaluate its financial viability, considering factors such as initial investment, operational costs, labor savings, and productivity gains. The objective is to optimize the packing line to improve efficiency, reduce costs, and enhance overall profitability while maintaining the quality and safety standards of the packaged medicines.

RESEARCH DESCRIPTION

This research investigates the optimization of a manual packing line in a local pharmaceutical company by integrating the BIB-BOB machine, with a primary focus on assessing the financial viability

of this automation solution. The manual secondary packaging stage currently serves as a bottleneck in the production line, impeding efficiency and escalating labor costs. By exploring the integration of the BIB-BOB machine, which promises a higher output rate, this study aims to mitigate this bottleneck and enhance overall production efficiency. Moreover, in an industry characterized by stringent quality and safety standards, particularly in packaging medicines, ensuring that any automation solution preserves or enhances product quality while adhering to regulatory requirements is imperative. Thus, this research will evaluate the feasibility of integrating the BIB-BOB machine in terms of its impact on product quality and safety.

Furthermore, companies must continually seek methods to bolster productivity and curtail costs to maintain their edge in a fiercely competitive pharmaceutical market. Automation presents a promising avenue for achieving these goals by streamlining processes, reducing dependence on manual labor, and mitigating errors. This study will offer valuable insights into the financial implications of automating the secondary packaging stage through a comprehensive cost analysis, empowering the company to make well-informed decisions regarding technology adoption and investment. Ultimately, by augmenting production efficiency, trimming labor expenses, and upholding product quality, this research's findings can profoundly influence the company's competitiveness and profitability in the pharmaceutical sector.

RESEARCH DESCRIPTION

The primary objective of this research is to assess the feasibility and benefits of transitioning a manual packaging process to an automated one using the BIB-BOB machine, with the overarching goal of increasing the output of the packaging line. Automation presents a compelling opportunity to enhance productivity, reduce labor costs, and elevate product quality within the pharmaceutical manufacturing context. This study seeks to evaluate the potential advantages of automation while addressing challenges associated with implementation, including initial investment requirements, utility connections, and personnel training needs. By systematically analyzing these factors, the research aims to provide insights that will guide the company in making informed decisions regarding integrating the BIB-BOB machine into its packaging line, ultimately facilitating the achievement of higher production outputs and operational efficiencies.

RESEARCH CONTRIBUTIONS

This research significantly contributes to optimizing pharmaceutical manufacturing processes, particularly in packaging, through adopting automation technology, exemplified by integrating the BIB-BOB machine. Firstly, it provides strategic insights into adopting automation by comprehensively analyzing the feasibility and benefits of incorporating the BIB-BOB machine into the packaging line. By delineating the potential advantages, challenges, and considerations associated with transitioning from manual to automated processes, decision-makers in pharmaceutical companies are empowered to develop effective automation adoption strategies tailored to their specific needs and objectives.

Secondly, this research thoroughly assesses the financial viability of automation implementation, a crucial aspect for companies seeking to invest in new technologies. The study quantifies the initial investment requirements, utility connections, and personnel training costs associated with integrating the BIB-BOB machine through a detailed cost analysis. By providing clear insights into the financial implications of automation, decision-makers can make informed investment decisions that align with their strategic objectives, ensuring that automation initiatives contribute positively to the company's bottom line.

Lastly, this research enhances operational efficiency in pharmaceutical manufacturing by identifying opportunities for process optimization through automation. The study aims to streamline

operations, increase throughput, and reduce labor costs by addressing bottlenecks such as manual secondary packaging. Furthermore, by evaluating the impact of automation on product quality and safety, the research assures compliance with stringent regulatory requirements. It underscores the company's commitment to delivering safe and high-quality medicines. Overall, this research advances knowledge and fosters innovation in pharmaceutical manufacturing, pioneering novel approaches to process optimization by integrating cutting-edge automation technologies like the BIB-BOB machine.

RESEARCH BACKGROUND

The pharmaceutical company under study operates in the animal health industry, producing medications such as NexGard and Heartgard. NexGard protects pets against fleas and ticks [1], while Heartgard specifically addresses severe and potentially fatal Heartworm disease in pets. Heartworm disease, caused by foot-long worms residing in affected animals' hearts, lungs, and associated blood vessels, poses significant health risks and requires effective preventive measures [2]. This research focuses on optimizing the primary packaging process of Heartgard, a critical step in ensuring the quality and safety of the medication.

The current state of the primary packaging process for Heartgard involves three main stages [3]. Firstly, the chewable tablets undergo inspection using an Inline check weigher weigh machine at high speeds. This machine automatically identifies and rejects products that deviate from the specified weight requirements, ensuring product quality and consistency. Subsequently, the chewables are passed through a blister packaging machine, which utilizes positive pressure to form and seal blister-type aluminum (PTP)/plastic (PVC) packaging. This process creates stiff blisters with flat plates suitable for securely packaging the medication.

Following blister formation, four operators manually handle the blisters, filling the sleeves and arranging them onto shippers for transportation to the second facility. This manual handling process introduces potential inefficiencies, labor costs, and risks of human error, impacting overall production efficiency and product quality. Therefore, there is a pressing need to explore opportunities for optimization and automation within Heartgard's primary packaging process. By addressing these challenges, the pharmaceutical company can enhance operational efficiency, reduce labor costs, and ensure the timely delivery of high-quality medications to consumers.

Adopting automation in the pharmaceutical company's primary packaging process for Heartgard involves a substantial investment. The major components of this investment include the Universal BIB-BOB system for $114,560.00, visualization tools like K.HMI for $83,070.00, spare parts costing $15,130.00, and documentation expenses of $67,200.00. Additionally, the implementation requires conveyors ($21,000.00), additional stations or devices ($101,000.00), software ($80,000.00), and installation, run-in, and commissioning costs of $29,910.00. Packaging costs are estimated at $12,000.00.

These costs collectively sum up to a total implementation cost of $650,800.00. While this investment is significant, it represents a critical step toward optimizing the packaging process and improving overall efficiency. The company aims to enhance production speed, reduce labor costs, and minimize potential human error by automating the process. These improvements could lead to long-term financial benefits and increased competitiveness in the animal health industry. As such, careful analysis and consideration of this investment are essential in evaluating its impact on the company's operational performance and profitability.

Table 1
Major Machine Cost

Universal-BIB-BOB-System	$114,560.00
Visualization K.HMI	$83,070.00
Spare Parts	$15,130.00
Documentation	$67,200.00

Conveyors	$21,000.00
Additional Stations/Devices	$101,000.00
Software	$80,000.00
Installation/Run-in/Commissioning	$29,910.00
Packaging Costs	$12,000.00
Total Cost of the Implementation	$650,800.00

PROJECT METHODOLOGY

This study adopts a quantitative approach to evaluate the integration of the BIB-BOB machine into pharmaceutical packaging processes, focusing on key performance metrics, including production output, labor costs, savings per phase, operational costs, initial cost/investment of the BIB-BOB, and return on investment (ROI). The methodology emphasizes collecting, analyzing, and interpreting numerical data to assess automation adoption's financial viability and operational implications.

Quantitative data will be collected from various sources to provide insights into the performance of manual and automated packaging lines. Production output data will be obtained from production logs or databases detailing the quantity of products packaged within a specific time frame. Labor costs will be extracted from payroll records or accounting systems, encompassing expenses related to personnel involved in packaging operations. Savings per phase will be calculated based on reductions in labor costs, error rates, and other operational expenses achieved through automation adoption.

Operational costs, including maintenance expenses, utilities usage, and consumable supplies, will be obtained from financial records or expense reports. The initial cost/investment of the BIB-BOB machine will be determined based on procurement costs, installation fees, and any additional expenses incurred during the setup process.

Quantitative data will be analyzed using statistical techniques to derive meaningful insights and conclusions. Descriptive statistics, such as means, standard deviations, and percentages, will be calculated to summarize the performance metrics for manual and automated packaging processes. Hypothesis testing will determine the significance of differences between the two methods regarding production output, labor costs, savings per phase, operational costs, and ROI.

Regression analysis may be employed to identify relationships between variables and predict the impact of automation adoption on key performance indicators. ROI analysis will be conducted to evaluate the financial benefits of automation integration, comparing the initial investment with the savings achieved over a specified period.

The quantitative methodology outlined in this study provides a comprehensive approach to assess the integration of the BIB-BOB machine into pharmaceutical packaging processes. By leveraging numerical data sources and employing rigorous statistical analysis techniques, this approach aims to provide actionable insights into automation adoption's financial and operational implications, ultimately informing decision-making and optimization strategies in pharmaceutical manufacturing.

RESULTS AND DISCUSSION

In this study, we conducted a comprehensive analysis to assess the impact of implementing the BIB-BOB machine on a manufacturing facility's production efficiency and financial performance. Our evaluation considered various factors, including production output, labor costs, savings per phase, operational costs, and return on investment (ROI).

Table 2

Specs Before the Installation of the BIB-BOB

Operators	4	Mechanic	1
Salary for operators yearly	$70,000	Salary for mechanics yearly	$75,000
Total Salary Cost	$280,000	Mechanical Cost	$75,000
Total Salary Cost $355,000			
Production of Blisters per Minuto			

80
Production of Blisters Yearly ≈ 230,000
Production Cost ≈ $34,500

Regarding the impact on the production output, Before the BIB-BOB machine installation, the factory's production rate was 80 blisters per minute, resulting in an estimated yearly production of approximately 230,000 blisters. Following the installation, the production rate surged to 150 blisters per minute, indicating a remarkable increase in production output. Consequently, the yearly production escalated to approximately 450,000 blisters. This enhancement underscores the significant contribution of the BIB-BOB machine to augment production capacity.

Implementing the BIB-BOB machine resulted in a notable reduction in labor costs. Before its installation, the factory employed four operators and one mechanic, incurring a yearly salary of $355,000 for operators and $75,000 for the mechanic. The number of required operators decreased to 1 post-installation, while the mechanic's position remained unchanged. Thus, the total yearly salary cost diminished to $145,000, leading to substantial savings in labor costs. The calculated savings amounted to $210,000 annually, underscoring the efficiency gains of optimized workforce utilization.

Table 3

Specs After the Installation on the BIB-BOB

Operators	1	Mechanic	1
Salary for operators yearly	$70,000	Salary for mechanics yearly	$75,000
Total Salary Cost	$70,000	Mechanical Cost	$75,000
Total Salary Cost $145,000			
Production of Blisters per Minuto 150			
Production of Blisters Yearly ≈ 450,000			
Production Cost ≈ $67,500			

Although implementing the BIB-BOB machine incurred increased operational costs attributable to higher production volumes, the net financial impact remained positive. The escalated production costs were offset by the substantial savings in labor costs, resulting in a net profit of $177,000 annually. This demonstrates the machine's efficacy in enhancing operational efficiency and driving financial performance.

Return on Investment (ROI)

The return on investment (ROI) for installing the BIB-BOB machine was calculated to be approximately 27.2%. This indicates that for every dollar invested in the machine, the company can expect to receive approximately $0.272 in net profit annually.

Considering the net profit of $177,000 annually and given the total investment of $650,800.00

$$\text{Time to Recoup Investment} = \frac{\$650{,}800.00}{\$177{,}000} \approx \mathbf{3.68\ years}$$

This indicates that the initial investment in the BIB-BOB machine will be recovered within approximately 3.68 years, as reflected in Table 3. Consequently, the investment is expected to generate positive returns and contribute to the company's profitability over the long term.

Table 4

Payback Analysis (ROI)

Total Savings	$177,000
Total Cost	$650,800.00
Return of Investment	3.68 years

CONCLUSION

In conclusion, integrating the BIB-BOB machine into the pharmaceutical packaging process presents a compelling opportunity for the local pharmaceutical company to enhance production efficiency, reduce labor costs, and improve overall profitability. Our comprehensive analysis has identified significant benefits associated with automation adoption, including a substantial increase in production output and considerable savings in labor costs.

Before the installation of the BIB-BOB machine, the manual secondary packaging stage posed challenges such as low production efficiency, high labor costs, and the risk of errors. However, post-installation, the production rate doubled, and labor costs were significantly reduced due to the decreased number of required operators. The net financial impact remained positive, with a net profit of $177,000 annually, despite increased operational costs associated with higher production volumes.

The return on investment (ROI) analysis revealed that the initial investment in the BIB-BOB machine will be recouped within approximately 3.68 years, indicating the long-term financial viability of the automation solution. This signifies that the company's investment in the BIB-BOB machine will generate positive returns and increase its profitability over time.

Overall, our findings underscore the transformative potential of automation technology in pharmaceutical manufacturing. By embracing automation and optimizing production processes, companies can streamline operations, reduce costs, and enhance competitiveness in the market. The successful integration of the BIB-BOB machine exemplifies a strategic investment that aligns with the company's goals of improving efficiency, reducing costs, and maintaining product quality and safety standards. As the pharmaceutical industry continues to evolve, leveraging advanced technologies like the BIB-BOB machine will be critical for companies to stay ahead of the curve and drive sustainable growth.

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