

Comparative Analysis of Standardized Warehouses and Traditional Manual Warehouses

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Abstract. In the current systems of supply lines where the smooth execution of warehousing and sorting processes is the focus of operation as the decisive means to carry out a logistic system efficiently. As the development and penetration of e-commerce "Double 11" shopping festival, the management of other logistics is more challenging due to the unprecedented surge of orders. Traditional manual warehouse will need a great amount of labour to undertake picking and sorting labour, and will rely on increased numbers of shifts, increased numbers of people in peak periods and therefore, require temporary workers too. In contrast, the standard warehouse with connected information and automation devices and information systems has an efficient yet stable capacity, and the capacity is appropriately maintained during the peak time, and the quality is well maintained as well. The research is examining the differences between automated warehousing compared to the manual warehousing with the help of production efficiency and labor cost analysis as JD Logistics and SF Express Holding automated warehouses that have advantages in longer durations and may be costly depending on construction time; and are popular for their cost-efficiency. Manual warehouse was developed with retained value of flexibility coupled with low barrier to entry. Overall, automated warehouse will be the mainstream solution; whereas manual warehouse will be used as a supporting solution in some cases.

Keywords: Standardized Warehouse, Traditional Manual Warehouse, Supply Chain Management.

1. Introduction

The e-commerce sector and the manufacturing industry is progressing at abnormal rates triggered by globalization and digitalization. Especially in China, e-commerce has become a powerful growth driver of the economy, which imposes very high requirements on the logistics and warehouse. The consuming behavior of the consumer is transitioning into the domain of e-Commerce, the orders are exponentially expanding. Take Simmons' Double 11 shopping festival as an example, the express shipment volume reaches over 701 million pieces, the national express volume greatly exceeds the normal business level; not only did the logistics industry set a record, it also confirmed that the order processing capability is a business competitive advantage. As a crucial link in the whole supply chain, the effectiveness of warehouse affects directly the speed of logistics at the end of Indian production and the satisfaction rate of overseas markets directly, therefore, the study of warehouse model are necessary and have great practicality.

Warehouse operation is gradually divided into two types, one is the traditional warehouse operation, which is mainly revealed at the labor-intensive warehouse and at the standardisation based warehouse function, and the other is the automated technology based automated warehouse function. Traditional manual types, that led the industry in the early days, reached significant heights with vast labor force of picking and segregating people, and packaging. They were shipped with low building barrier and quite a lot of flexibility - the dark sides of this model. However, this model may not have been pursued when the number of orders steadily increased, as this approach still has some disadvantages. There is usually huge movements of level of activity during the peaks, those peaks would require the companies to use overtime and even to hire temporary workers to sustain the situation, so the variable labour costs would be very high, the qualities of the employees are also very different. There is a standardized warehouse, the logistic flow is automaticized through the use of conveyor-belts, sorting machines and is connected with an intelligent information system. Primarily, they are of productive

size (overall production stage) and, presumably, slightly undercapitalized as they are produced on a mass scale and attract lots of customers. However, the disadvantages are not least here as well as the advantages: they are extreme fixed costs for the provision and maintenance, which can be a highly burdensome investment for smaller and medium-sized companies.

The analysis of the standardisation warehouse and manual warehouse in peak production and employment period is not only applicable to other functions of the day of peak advantage of the warehouse, but also can be more used to image the importance of warehouse mode to the efficiency of the whole supply chain. The matrix research is concerned with the material acronym vis-a-vis the enterprise management and its investment decision, and eventually, the strategic decision. Management of operation efficiency: In our Express logistics enterprises, whether in the area of eCommerce, scope, or operating scale, the cost needs effective management. On the other hand, the enterprises require multiple service support and fast response capability in dynamic emergency condition in both a support function and brain simultaneously. Moreover, changing the typology of the warehousing network, lends itself to further aspects to the long term view of the stability and strength of the supply chains from an industry perspective. Using automated warehousing will be one of the trends because the labor costs are always increasing. However, how to achieve an appropriate balance between manual and automatic labor with respect to various types of cases is currently an important question in practice for enterprise and for the policy-making agency.

The significance of this study lies in its systematic comparison of operational differences between standardized warehouses and traditional manual warehouses during peak periods, revealing the influence mechanism between warehousing models and supply chain efficiency. By analyzing annual data from JD Logistics and SF Express Holding along with relevant statistical information, the research will examine the performance of different models in terms of production efficiency, labor costs, and supply chain coordination. The findings not only provide decision-making support for corporate warehouse investment and operations but also offer policy references for governments promoting intelligent logistics and optimizing industry structures. In other words, this research holds academic value while also providing significant guidance for industry practice and policy formulation.

The structure of this paper is as follows: Part One introduces the theoretical foundation and analytical perspective, reviewing relevant academic and practical research; Part Two provides a detailed comparison of production efficiency and labor cost differences between standardized warehouses and traditional manual warehouses during peak periods; Part Three summarizes the research findings, analyzing the advantages, disadvantages, and applicable scenarios of both warehouse models; Finally, conclusions and policy recommendations are proposed to provide reference for the future development direction of the industry. Through this structure, this paper aims to comprehensively present the value and significance of comparing warehouse models, addressing core issues faced by enterprises and the industry amid rapid development.

2. Research Perspective and Theoretical Basis

Both academic research and industry practice demonstrate distinct characteristics of automated versus manual warehousing. Christopher notes that automated warehousing shortens operational cycles, enhances efficiency, and reduces long-term costs [1]. Pinker and Shumsky found a clear trade-off between worker efficiency and quality in scenarios involving cross-skill training and multi-task utilization, explaining the volatility in peak-period efficiency observed in traditional manual warehouses [2].

From a labor economics perspective, Benjaafar et al. argue that platformization and automation can enhance labor welfare and reduce worker intensity, but simultaneously diminish the flexibility of manual positions [3]. In other words, standardized warehouses reduce labor requirements through automated equipment, yet this necessitates substantial upfront investment and long-term maintenance

for enterprises. In contrast, while manual warehouses demand greater labor input during peak periods, they retain advantages in small-scale or uncertain demand environments.

Furthermore, warehouse optimization research provides theoretical support. Ding and Kaminsky highlight the impact of centralized versus decentralized warehouse collaboration on overall efficiency, emphasizing the importance of systemic thinking [4]. Rijal et al.'s research indicates a close dynamic relationship between warehousing and transportation, suggesting that efficient warehouse models influence not only single-point efficiency but also the coordination capabilities of the entire supply chain [5,6]. Collectively, warehouse model selection transcends mere efficiency comparisons, encompassing cost, flexibility, and overall supply chain synergy.

This study employs secondary data analysis, primarily sourced from JD Logistics and SF Express Holding's 2024 annual reports, alongside public information from the State Post Bureau and National Bureau of Statistics [7-9]. By contrasting JD's performance under automation investment with SF Express's cost pressures stemming from labor dependency, it can more clearly reveal the differences between the two models during peak periods.

3. Comparative Analysis of Standardized Warehouses VS. Traditional Manual Warehouses

3.1. Peak-Period Productivity Comparison

During peak seasons, a warehouse's ability to rapidly process orders becomes a critical efficiency metric. The conventional warehouses are manual warehouses that use a large number of employees to pick, sort, and pack products. When the demand is low on a day, this model is useful for adjusting the capacity by taking extra staff or laying down staff by firing. However, when there are huge shopping festivals such as the Double 11, the volume of orders usually experiences a sharp peak, with a volume of 3 to 5 times more than the average daily volume. Manual warehouses, on the other hand, largely manage to increase the capacity by extending labour hours and employing temporary labour. This not only causes problems in terms of managing staff members, but in again introduces a large labour intensity. Sluggish workers will perform less efficiently and will be more prone to errors than they usually are. As implied by SF Express Holding's annual report article, the re-work rate and complaint rate for the company go up drastically during peak times due to the inefficiencies of manual operations when huge demand spikes happen [7].

A good example is when there was a challenge in the operations in the warehouse during the Double 11 sales event whereby the manual warehouses which used by the JD.com faced challenges. The increase in demands made the operational starting to be big because there was need to hire addition employees to help in the management of the supply chain which was costly. Also, the manual process is prone to errors and slow in work rate because to maintain god quality, the addition employees needed to be a little slower in their activities in the warehouse.

Standard warehouses use items such as automated conveyor belting, sorting machines and information platforms, which are designed to help the operations stay the same during the peak periods. JD Logistics has passed the test in the past few years as the sales ideal scene comes near. It has reached the level of over 10 million shipping per day, which greatly exceeds the processing capacity of most distribution centres (note that single warehouses are involved here rather than combinations), due to their manual mode primary mechanism. "Machine stability is thus based on machine work without physical limitations, and thereby before of equal efficiency across the long duration." At the same time, the automated system minimises the levels of error existing in manual operations, with the order picking accuracy much higher than in manual warehouses, while the rate of outbound is much higher than what is possible during manual operations. Automated warehousing is capable of handling more orders per unit hour, creating economies of scale.

Traditional manual warehouse uses a manual labour management mode. It has the characteristics of warehouses distributed in some places to leave enough space for outweaving and personnel circulation, and the space utilisation rate is low. Warehouses, on the other hand, are standardised;

they use vertical shelving systems and automated sorting systems, which utilise maximum density possible for the amount of storage space available on the floor space. According to various studies, there is usually greater than 30% space specialisation in completely automated warehouses compared to classical warehouses. This not only increases the throughput as a whole, but also reduces the costs of land and increases the facility. Thus, standardised warehouses show much better efficiency in the operational activity and space utilisation in peak hours compared to a conventional manual warehouse.

3.2. Labour Costs

Warehousing models differ in the expense of labour, both direct and indirect. In a conventional manual warehouse, the direct costs that mostly occur are the wages of workers, the cost of overtime workers, and the staffing costs for temporary workers. With the increase in labour costs, the cost of wages increased year by year, especially in tier one Chinese cities, and wage cost takes up a heavy burden on the enterprise. According to SF Express Holding's financial report in 2024, its labour cost began to exceed 110 billion yuan, which takes up nearly half of its expenses. However, if businesses representing the peak Companies were subjected to an increase in the force of the total crew, this would inevitably increase the cost of that operation [7]. On the other hand, manual warehouses have to assert the direct contribution of labour to the operations, whereas streamlined warehouses do not; hence, you will save in labor costs a great amount of money every single order. While automated warehousing is expensive in terms of capital outlay, at the initial level and even well beyond, its average costs will decrease and result in strong economies of scale.

Hidden costs impact traditional manual warehouses [10]. Firstly, operations with a manual labour dimension of one human operator have high error rates and re-work, high-quality levels not achieved and customer re-work, which leads to an increase in operational costs, and sometimes damages the corporate brand as well. Second, as there is a requirement to employ a temporary work chain in the peak seasons, the training costs added to the operational management costs further decrease the overall efficiency of the operation. In contrast, in the case of the normal warehouses, the hidden cost is mainly from the maintenance of equipment and system upgrades. These costs are in a fixed share and are more or less controllable in terms of the fact that they do not increase significantly in an increased peak period of orders. Automated oxidative decomposition models offer a good potential for the mitigation of the risk of regular fluctuation of the workforce, ensuring an uninterrupted and steady nature of the operation.

The operation of the standardised warehouses shows the obvious advantages in the fields of production efficiency and space utilisation in the peak season, and the advantage of greater management in the long term in the field of labour cost. On the other hand, despite its flexibility and ease of kicking in, traditional manual warehouse solutions reach their breaking points when there is a surge in order processing costs with high inefficiencies. Among the models, there is no incompatibility, but only a preference depending on the size of the company, its financial resources, and business activity needs. Solution: For smaller companies, it is more suitable to focus on systems of capabilities rather than investing in large-scale e-Commerce and express delivery companies such as such an automated warehouse concept will gain some rule of scale. In the short term, Small and Medium-sized Enterprises (SMEs) could either continue to have manual operations or, in combination of efficiency and costs, hybrid models of having manual and automated operations.

Peak seasons in the supply chain warehouses is estimated to always cause a surge in costs of labor by around 20% to 30%. This comes a reason for the need of addition employees during the peak seasons as opposed to the automated processing of activities in the warehouse during the peak season. An example is the case of SF Express which announced in the financial years that they incurred an increase of their operational costs by 15% in 2024 during the peak seasons. However, those other logistics companies which had automated their activities such as JD logistics had an advantage whereby, they experienced a reduced labor costs by around 10% in automation of activities which still maintained a high quality of output while maintaining high efficiency rates.

Integration of hybrid models with the current technologies such as warehouse automation is the practical solutions which the logistics companies' needs in order to achieve maximum efficiency. A good example is the case of SF express which has managed over the recent years to have both automation and manual labor whereby the automation is done at sorting stage while picking stage remains to be manual. This improves the accuracy and the quality of the logistics products. Technologies such as AI, IoT and robotics are widely used in the current generation to maintain the flexibility of the work. These new technologies bridge the gap between the manual and the automated activities hence greatly improving the output of the task.

4. Conclusion

Based on the comparison of the standardised warehouse and the traditional manual warehouse, in this paper, the key differences and characteristics of the two kinds of models from the peak operations are summed up in comparison with each other. Standardised warehouses facilitated by automated material handling equipment and sophisticated computerised information systems have demonstrated great profitability in terms of productivity levels and low routing error rate during an order surge and when implemented at scale. On the other hand, while traditional manual warehouse has a relatively low barrier to construction, the emergency flexibility is easy, with many serious fluctuations in efficiency and potential for human error and their ever-increasing cost to employees and burden of work. It is especially challenging to maintain stable levels of operations during certain peak periods. Therefore, in the overall trend, the automated warehouses have become the mainstream direction of industrial construction for a long time, and the manual warehouses will be kept as the secondary model in a certain warehousing operation environment. More importantly, this study demonstrates that warehousing models not only affect the effectiveness of single nodes, but have a great impact on the responsiveness of an overall supply chain as well as on their capability of cost and coordination. This finding provides robust support for strategic decision-making by enterprises and the industry.

Based on these findings, this paper proposes three recommendations and future outlooks. First, large e-commerce and express delivery enterprises should accelerate the deployment of intelligent warehousing, leveraging technological upgrades and information platforms to enhance economies of scale while reducing reliance on labor through continuous optimization. Second, small and medium-sized enterprises with limited capital can adopt a hybrid approach combining manual and automated operations, gradually introducing automated equipment to improve efficiency while maintaining flexibility and avoiding risks associated with over-reliance on a single model. Finally, at the policy level, governments should support the widespread adoption of smart warehousing through subsidies, standardization, and talent development to enhance the industry's capacity to handle peak periods. Looking ahead, as artificial intelligence, the Internet of Things, and big data technologies advance further, warehouse models will evolve toward greater intelligence, flexibility, and diversity. Enterprises should not view automation solely as a tool to replace human labor. Instead, they should explore a "human-machine collaboration" development path from the perspective of overall supply chain optimization, achieving dual improvements in efficiency and resilience.

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