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ORIGINAL ARTICLE

# WAREHOUSE PERFORMANCE IMPROVEMENT DURING BIG EVENT USING DISCRETE EVENT SIMULATION: A CASE STUDY AT AN E-COMMERCE COMPANY

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**ABSTRACT** – The purpose of this study is to see how customer demand changes when Malaysian e-commerce hosts a major event that affect the warehouse operations. This is due to the fact that, when compared to non-major events, the pricing are very reasonable. As a result, when the major events happen, e-commerce especially the warehouse operations will face significant challenges in managing customer orders. Long lines can be found in the picking and packing sections. Orders will then be shipped later than anticipated. In this study, Company X is one of the e-commerce companies affected by this issue. Discrete Event Simulation (DES) software which is ARENA simulation was used as the method in measuring the warehouse performance under study. By introducing several scenarios that are appropriate for company X, the company's warehouse performance is found to be more efficient in terms of reducing process queuing time and resource utilization. Although the queue time for the process is positively impacted by all scenarios, the owner of company X must bear higher costs to do so. The likelihood of avoiding a delay in the order cycle time increases with increasing cost. However, everything hinges on Company X's own budget.

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## INTRODUCTION

### Case Background

Electronic commerce, also known as e-commerce, has increased significantly around the globe including in Malaysia. E-commerce is a business model that enables most small and large businesses, as well as individuals, to sell and purchase goods and services over the internet. In other words, an e-commerce system functions as a bidirectional information transfer channel, a platform for transacting, an interface for providing customer service, and a tool for marketing initiatives (Xie & Wang, 2021). Among the popular e-commerce platform in Malaysia are Shopee, Lazada, Lelong.com, and Zalora.

Every month the e-commerce platform will hold a special event, also known as "Sales," where they will offer numerous discounts on a specific day. 11.11 Sales, for example, is a popular event held by one of the e-commerce platforms in November. Most of the items are offered at a very low price during 11.11 Sales, which will entice many of their customers to wait for the event to take place. As an outcome, a significant increase in customer demand always occurs on the day of the event (Chen & Li, 2021). As a result of the increasing customer demand, e-commerce frequently faces the issue of queuing in the process of taking and packing customer goods. As a side effect, customers received their goods later than anticipated. These will create customer dissatisfaction and losses in terms of sales for the business. If this queuing problem is not properly addressed, the e-commerce business will suffer greater losses (Edmonds, 2021). Hence, in order to stop the company from making a loss, the management or manager must act quickly. Further issues will emerge if the executive in charge of the organization's performance is underqualified. For instance, the issue of a worker shortage during the holiday rush and the lack of automation equipment in the warehouse will increase the chance of queuing times getting longer.

Queuing problems can arise in a variety of industries, including the medical, industrial, manufacturing, and commercial sectors. The main cause of queuing problems in all industries is a lack of resources (such as workers or equipment) or problems with their workflow. As a result, this issue has been researched in the pharmacy sector, where changing and improving workflow has successfully solved the queuing problem (Yemane et al., 2021). Therefore, e-commerce must capitalise on this opportunity based on the solution ideas that have been identified.

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Using appropriate simulation software, the objective of this paper is to evaluate the performance of warehouse workflow in e-commerce during the big event period by using Discrete Event Simulation (DES), and also to propose a better configuration of warehouse workflow in order to increase the case company efficiency. In this study, a company of Malaysia's major e-distributors considers improving their current performance of warehouse workflow to make it faster, more accurate, and more efficient. The sections that follow will go over previous literature on the ethics in warehouse management and also the theoretical foundations of simulation modelling. Following that, the research methodology is refined. The results and discussion are then highlighted. Finally, at the end of this paper, the conclusion is mentioned.

## LITERATURE REVIEW

### Ethics in Warehouse Management

The social responsiveness of a firm is referred to as ethics in management. It is "the discipline concerned with what is good and evil, right and wrong, moral responsibility and duty." To put it another way, management ethics can be characterised as a set of moral principles that guide a person's or a group's behaviour. It is a standard of conduct that guides managers in their daily activities. Business ethics are shaped by a company's basic principles. Managership is also required for the formation of an ethical culture. This is especially true for managers that demonstrate honesty, unity, and respect (Sarma, 2020).

It is a hotly debated topic whether business ethics are improving or deteriorating. Whether the behaviour is improving or deteriorating, warehousing is an activity where ethics are very important. Exploration of the ethical process in warehousing is important for three reasons: the warehouse manager is accountable for other people's property, failing to follow promises made in warehousing can result in serious consequences, and warehousing requires competent and experienced workers. High personnel turnover is almost often accompanied by a lack of skills and trust, and competitive third-party warehouse margin pressure may drive individuals to engage in unethical activities when buying or selling services.

Therefore, warehouse management's ethical responsibilities must be taken seriously. This aspect is closely related to the performance of a person in an executive position, such as a chief or, more commonly known, a warehouse boss. This is because if a manager fails to gain the trust of his employees, it will pose a significant risk to warehouse performance. There are several approaches to combat the problem.

The first thing that any executive employee must do is always keep their promises. In today's warehouse management world, failure to deliver to customers on time due to a delay in the picking and packing process can result in massive losses. Moreover, keep promises involving the employee-management relationship. If a large number of employees are absent on the first day of the hunting season, warehouse managers may be unable to meet customer expectations. Absences and tardiness at work contribute to the inability to keep an operating schedule. Therefore, the ability to keep promises is critical for warehouse operators to maintain their reputation and trust. Employees, suppliers, and other managers must all work together to keep that promise.

The second thing to bear in mind is to constantly have belief in the employee. Unlike manufacturing, warehousing does not necessitate a high level of inspection and control. As the employee toured the building picking out things for outgoing delivery, it was evident that it was impossible to follow the warehouse order picker path. This gives negligent or unscrupulous warehouse personnel plenty of opportunities to choose the wrong item, ship damaged items, or commit criminal theft in the transfer of commodities in and out. When all employees are trustworthy, such a thing will not occur. There are two ways to make each employee do so: by treating them with compassion and respect, and by always caring about them. The second method is through close relationships. This is due to the fact that trust will exist on its own once the employees recognise each other's generous hearts (Ackerman, 2015).

Failure to carry out warehouse management's ethical responsibilities will result in dangerous ethical problems. The first issue is the use of inadequate security equipment. Some businesses in every industry will prefer to use subpar equipment and products. This is one of the most serious ethical issues confronting warehouses. For example, a shelf may be out of date, posing a hazard to workers if it collapses. Businesses may fail to provide adequate safety equipment, such as gloves and hard hats. It is also not uncommon for businesses to use outdated equipment that lacks built-in security features. Instead of upgrading, they continue to use hazardous equipment that puts workers in danger.

The second ethical issue that will arise is a shortage of warehouse management employees. Every employee, as is well known, requires time to perform their tasks safely and productively. They should never be put in a rushed situation while performing any work, such as using a forklift in a warehouse. Therefore, to avoid employee injury, the head of each department must always issue a warning to their employees. The likelihood of this problem being solved is by incorporating the use of automatic systems into the warehouse layout itself. Although the cost is high, the most important aspect is that employee safety is ensured (Ethical Advocate, 2020).

In conclusion, unethical warehouse management yields little profit. In fact, it is a burden to them. For example, a faulty product will harm a company's reputation, prompting them to resign. When a warehouse develops a bad reputation as a result of the bosses' failure to properly treat the workers, it becomes more difficult to find good workers. Furthermore, employees eventually win their lawsuits, which can completely devastate the company.

## Performance

The manner in which work is completed is referred to as performance. This performance is classified into three levels: good, moderate, and poor. Performance measures have been introduced to identify a warehouse's performance. According to Öz and Özyörük (2021), performance measurement is the process of determining the efficiency and effectiveness of a particular action or activity. This performance metric's primary goal is to determine whether the current situation is proper. If not, the process of identifying the causes of poor performance should begin as soon as possible.

Therefore, there are several reasons to measure performance (Bjørgen et al., 2019). The first reason for measuring performance is to improve current performance, such as improving delivery performance so that loyal customers are satisfied with the services provided. Aside from that, by measuring performance, major issues that could result in significant losses to the company can be avoided sooner. Despite the fact that the difficulties encountered are minor, failing to overcome them from the start will have a significant negative impact in the future. Following that, the purpose of measuring performance is to control processes and costs. When a warehouse performs performance measurements, it gives the warehouse the opportunity to identify and eliminate bottlenecks in the warehouse process. The warehouse's costs can be kept to a bare minimum as a result of this. The final reason for measuring performance is to keep track of customer relationships. If customer relationships are not prioritised, losing loyal customers will result in higher losses than losing regular customers. This is due to the fact that gaining customer trust is not a simple or quick process. That is why a company values its loyal customers.

To summarise, performance measurement is critical for a warehouse to run smoothly and efficiently without incurring high costs. The risks that the warehouse will face can thus be avoided or reduced to the greatest extent possible.

## Warehouse Performance

A method of measuring the performance of activities, programmes, or services provided by a warehouse is warehouse performance measurement. In this warehouse performance measurement, there are four categories: input, output, efficiency, and effectiveness (Kumar et al., 2021). Efficiency and effectiveness are frequently used as performance indicators.

Moreover, there are numerous methods for classifying warehouses based on these performance indicators. This warehouse's performance is based on traditional logistics performance metrics such as 'hard' and 'soft' metrics. Phyllis (2021) made a distinction between direct and indirect indicators, with hard indices falling into the latter category.

Therefore, key indicators are used all over the world to assess warehouse performance. The first is from Colson and Dorigo (2004) which provides software tools for selecting public warehouses based on the following criteria: storage surface and volume; dangerous goods; temperature control; segregation of storage areas; geographical distance to highway, rail, and waterway connections; certification; opening hours; customs assistance; use of technology; handling equipment; number and characteristics of docks, and others. Next, Elfriede et al. (2005) categorised more than 100 indicators used to evaluate warehouse performance, including storage surface, storage volume, storage racks, number and characteristics of docks, pallets per hour, pallets per square metre, opening hours, and customs assistance Finally, three types of indicators are used in Liviu et al. (2009) study which are order fulfilment, inventory management, and warehouse performance.

## Issues and Challenges in Warehouse Management

Apart from receiving and transporting goods, warehouse management entails planning storage, supply, and inventory control. Finding better ways to manage warehouses may allow the company to save money, save time, and increase revenue and customer satisfaction. As an outcome, this section will highlight some of the difficulties that are frequently encountered in managing a warehouse.

According to Solistica (2019), a common issue in warehouse management is the lack of warehouse space. This limited space issue arises as a result of items that are constantly accumulating and are not well organised. As a result of this issue, work accidents will occur, time will be lost in product research, and the quality of goods will suffer. Therefore, by maximising vertical space, you can improve the efficiency of quoting operations while also lowering inventory and operating costs.

Furthermore, one of the challenges in warehouse management is poor time management. The best way to significantly improve this issue is to optimise inventory selection and location. The inability to pinpoint the exact location of a product will have a negative impact on execution time and will slow down the entire supply chain. As a result, using automation tools such as barcode technology, RFID labels, and order management systems provides adequate inventory and logging information in real-time. This allows for the avoidance of repetitive tasks while also significantly reducing execution time (Solistica, 2019).

Next, seasonal demand is a common challenge in warehouses (Reid, 2020). For warehouse managers, demand fluctuations are a major headache. The recent global financial crisis caused a drop in sales due to rising inventory levels, causing major cost problems for warehouses. While the issue does not affect all industries in the same way, it does highlight the difficulty of demand fluctuations caused by factors beyond the control of warehouses. Seasonal demand necessitates accurate and timely manufacturing, retail, and industry data. Information gaps between warehouses and other related entities or industries make it difficult for distributors to monitor and respond to changes in demand. Warehouses must use current and accurate data in demand planning and forecasting, as well as providing supply chain visibility. Rearranging products to match demand changes helps to mitigate the negative effects of seasonal demand. Such reorganisations entail placing high-demand items in front of the picking aisle and at the proper height during the current season.

### Simulation Modelling

Simulation modelling is a technique that is frequently used to identify and explore alternative solutions, such as running a scenario and identifying the consequences of the scenario. As a result, this modelling simulation has been widely used in various studies to address problems related to a location's workflow and operational aspects. This is due to the fact that the modelling simulation serves to improve the effectiveness of those aspects. Furthermore, these modelling simulations allow users to make changes and experiment without affecting the real-world situation. As a result, the use of this modelling simulation is common in a variety of organisations such as health organisations, logistics organisations, manufacturing organisations, and so on. For example, a successfully demonstrated Discrete Event Simulation (DES) is the best modelling simulation approach for solving problems in waiting time for patients (Amelia et al., 2021). As a result, using the same approach in this study, modelling simulation such as DES can have a significant impact on improving the performance of the company's case. Knowing how this DES process is carried out can thus provide a more in-depth understanding of this study.

DES, in general, replicates a process as a sequence of events, with each event having a starting point and an ending point that is typically measured in time. A state variable that measures the state of the simulated process is associated with a discrete point in time. As a result, when a simulation runs through a series of events, the process under simulation appears as a series of state changes. The analysis can then be focused either globally or as designed in any specific simulation. A simulation run occurs after the construction of an accurate model that accurately represents reality. The simulation run will be repeated several times to ensure a statistically acceptable outcome (Kasim et al., 2021). The events intended in this DES are very flexible, allowing this study to conduct a "what-if" scenario without encountering any issues. The data obtained from the simulation will then be used to determine the best solution to smooth operations in the warehouse while also improving warehouse performance.

## THE CASE COMPANY

### Background of the company

Company X is one of Malaysia's largest local e-commerce enablers. The company's main function as an e-commerce enabler is to take the guesswork out of e-commerce operations for their partners in collaboration with brands by providing a complete management system and fulfilment solutions. In less than three years, the company has grown exponentially, becoming a full e-commerce enabler. The company manages and operates one of the well-known food and beverages official stores across Malaysia's e-commerce platforms, such as Lazada, Shopee, Alibaba, PGMall, Astro GoShop, and others

During their time in business, the company under study has been recognised for a number of accomplishments and awards. Since November 2017, the company has achieved 1.2 million sales in just 24 hours for the 11.11 Sale. They won three prestigious awards in January 2018. In the year 2020, the company also received two noteworthy achievements, both of which are extremely valuable to the company: the 2020 E-commerce 11 Mega Day Outstanding Sales Award, as well as a 57 per cent increase in the E-commerce Market compared to 2019.

In conclusion, the company under study is one of Malaysia's most significant e-commerce enablers. If the company has a service failure, it will have a significant impact on customer satisfaction. To avoid any unwanted problems, the company places a high priority on improving delivery performance to gain more loyal customers.

## RESEARCH METHODOLOGY

This case study was done using a quantitative approach for the data collection. A quantitative data collection method is used to ensure that the details and knowledge gathered are reliable and solid. An interview session was conducted to better understand the company's process flow in order to develop a model using discrete event simulation (DES).

ARENA software was used in this study. The software's capacity to define object pathways and routes for simulation, statistical analysis and report generation, and realistic 2D and 3D animation capabilities to see results beyond statistics are all additional advantages of utilising ARENA simulation (Dias et al., 2022).

Due to that reason, ARENA simulation was used in designing new warehouse layouts as well as a place to test scenarios that will be one of the leaps to the company's case to be more efficient in the future. A validation and verification process was carried out to ensure that the simulation accurately represents the actual process. This procedure is used to determine how much difference exists between the simulated model and the actual process. If the total difference is less than 10%, the simulation can be considered as accurate. The simulation was then run in accordance with the scenario that was specified, and analysis was done after.

### DES Modelling Process Flow

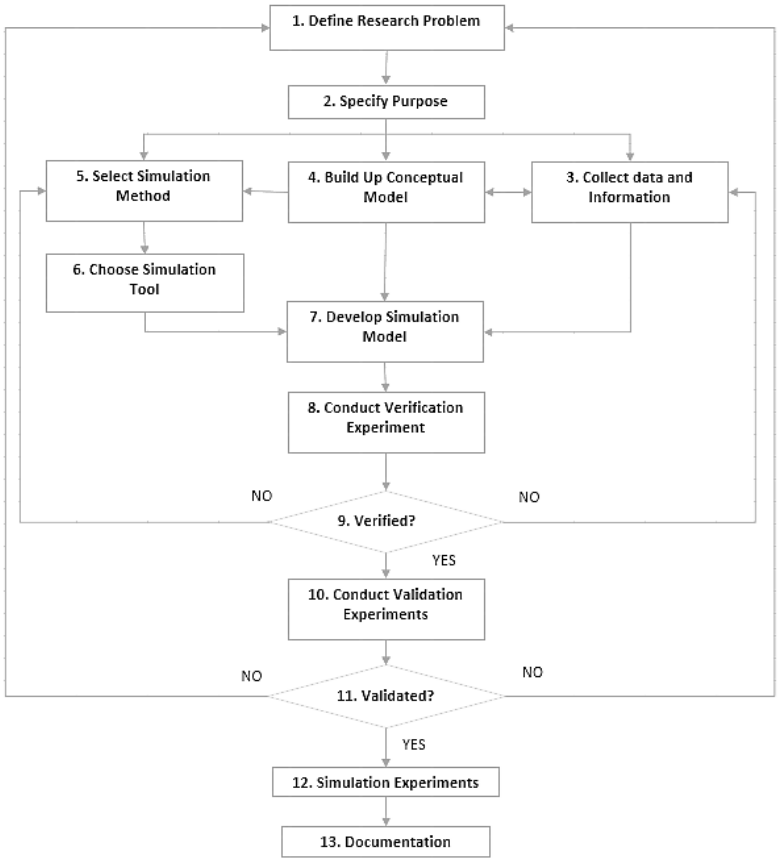


**Figure 1.** DES modelling process flow (Yin & Mckay, 2018)

Figure 1 depicts the procedure of process flows for DES modelling. This procedure began by identifying the issues in the case company. The model was then built and simulated by mimicking the real warehouse operation by using the data and information gathered from the case company. Following the successful construction of the simulation model, a verification and validation process must be performed to ensure that the simulation is accurate with respect to the actual system. Once the simulation model is accurate, the simulation experiment (what-if analysis) can be carried out and the best suggestion can be identified.

## Method

ARENA 16.0 Simulations software was used to create the current company's warehouse process simulation model. This simulation model begins with the customer ordering online at Lazada Mart and continues until the customer receives their order or goods successfully. This study's simulation model includes several basic components, including a Source, Queue, Delay, and Sink. Following that, in this simulation model, (source) represents the customer ordering online at Lazada Mart which means the company already received the orders, and (queue) describes the order or customer's goods that are still in the process of being managed by the pickup staff from the moment it enters the company's service. Each row represents an order that needs to be handled. The delay simulates the delays associated with the company's services. The sink is used to round out the flowchart. The company will consider the changes made to increase effectiveness and efficiency, as well as to reduce waiting time for customer orders, based on:

I. Increasing the number of existing employees in the pickup and packing section to six people.
II. Changing the layout and adding automatic systems.
III. Increasing the number of existing employees in the pickup and packing section to six people and using the automatic systems with the new layout.

## Current Warehouse Layout and Workflow

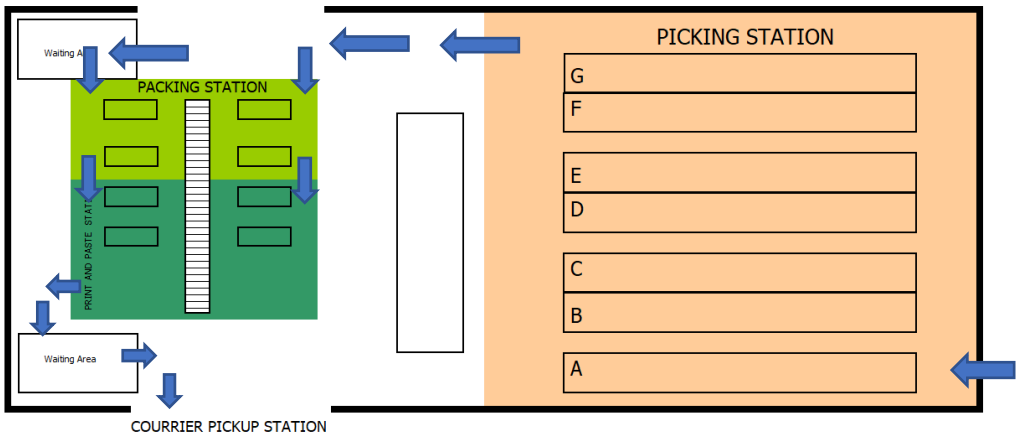


**Figure 2.** Current Warehouse Layout

Based on Figure 2, the current warehouse workflow begins with the customer placing an order based on their preferences. The order is then processed at the picking station. There are four picker workers at the picking station who will go to pick up all of the goods or orders that have been made according to the correct amount and the correct goods. Following that, the picking station will be taken to the packing station for the packing process, which has four packing workers. Once properly packed, the package will be delivered to the printing station, where it will be printed, and the customer's information will be put on the correct package. Following that, the courier will arrive to collect the customer's package and load it into the courier van. Finally, customers only need to order or have their packages delivered to their front door.

## What-if Scenarios

In this study, three alternative scenarios are proposed to improve the company's service efficiency while also increasing customer satisfaction. According to the company, one of the main obstacles to customers receiving their orders and goods was the lack of employees during the big event. As a result, this study will provide the suggestion for the company to make the best decision possible.

1. In the first scenario, the number of existing employees in the pickup and packing section is increased to six without changing the layout. This scenario begins with the customer placing an order based on their preferences. The order is then processed at the picking station. There are six picker workers at the picking station who will go to pick up all of the goods or orders that have been made according to the correct amount and the correct goods. Following that, the picking station will be taken to the packing station for the packing process, which has six packing workers. Once properly packed, the package will be delivered to the printing station, where it will be printed, and the customer's information will be put on the correct package. Following that, the courier will arrive to collect the customer's package and load it into the courier van. Finally, customers only need to order or have their packages delivered to their front door.

2. The second scenario involves the addition of automatic equipment, such as automatic printing, automatic pasting, and an RFID scanner. The new layout is shown in Figure 3. This scenario begins with the customer placing an order based on their preferences. The order is then processed at the picking station. There are four picker workers at the picking station who will go pick up all of the goods or orders that have been placed in the correct amount and with the correct goods. When the packing station successfully receives the ordered goods that were taken from the picking station, the goods will be packed at this packing station, which also has four packing workers. Once properly packed, the package will be taken to the Automatic system station for the printing process, where customer details will be put on the correct package and then the RFID scanner will make sure that all the orders are correct in a fully automatic system. Following that, the courier will arrive to collect the customer's package and load it into the courier van. Finally, customers only need to order or have their packages delivered to their front door.

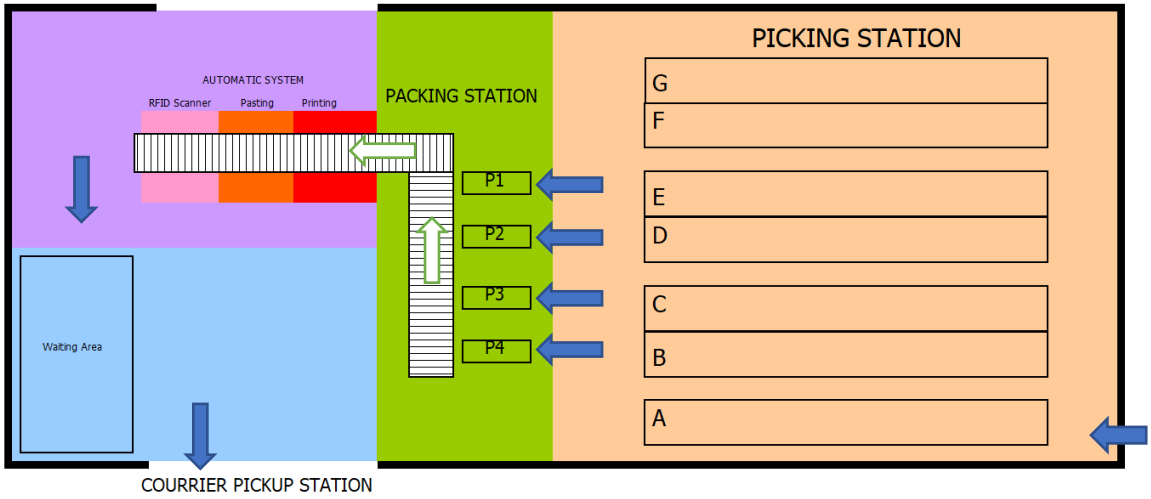


**Figure 3.** The new improved warehouse layout with Automatic Systems

3. The third scenario involves increasing the number of existing employees in the pickup section to six and utilising the automatic system with the new layout as in Figure 3. This scenario needs to begin with the customer placing an order based on their preferences. The order is then processed at the picking station. There are six picker workers at the picking station who will go to pick up all the goods or orders that have been made according to the correct amount and the correct goods. When the packing station successfully receives the ordered goods that were taken from the picking station, the goods will go through the packing process, which also has six packing workers. Once properly packed, the package will be taken to the automatic systems which are starting with printing and pasting. Then, the RFID scanner will make sure that all the orders are correct. Following that, the courier will arrive to collect the customer's package and load it into the courier van. Finally, customers only need to order or have their packages delivered to their front door.

## RESULT AND DISCUSSION

### Verification and Validation

**Table 1.** Replication Analysis

| Process/Replication (min) | 1 | 2 | 3 | 4 | 5 | Replication Mean | Actual Mean |
|---|---|---|---|---|---|---|---|
| Picking Process | 16.9512 | 17.7971 | 17.0134 | 16.6953 | 16.2904 | 16.9495 | 18.6355 |
| Packing Process | 17.4024 | 15.9570 | 17.0724 | 17.0235 | 17.1918 | 16.9294 | 17.3963 |

**Table 2.** Model Validity Analysis

| Process | Difference | Conclusion |
|---|---|---|
| Picking Process | 9.04% | Model Valid |
| Packing Process | 2.68% | Model Valid |

$$Difference\ (\%) = \frac{Simulation\ output - Actual\ data}{Actual\ data} \times 100$$

Throughout the model simulation development, verification and validation are carried out, in the same manner, to ensure that the design, functionality, and processes built into the simulator accurately represent the real operation of the company. So, using the difference formula (per cent) as described above, this study can determine the validity of the model. As shown in Table 1, the simulation was replicated up to 5 times in order to obtain the mean number of replications for the picking process (16.9495) and the packing process (16.9294). Then, using the formula above, enter the two values. The results are shown in Table 2, where the simulations used in this study are valid because the difference between actual and simulation performance for both processes is less than 10% (Kasim et al., 2021).

### Findings

**Table 3.** Constant Variables

| | |
|---|---|
| Start time | 09.00 AM - 07.00 PM |
| Simulate | 10 hours = 600 minutes |
| Customers make orders (min) | RANDBETWEEN(1,8) |
| Picking process(min) | RANDBETWEEN(5,30) |
| Packing process (min) | RANDBETWEEN(5,30) |

**Table 4.** Process Per Entity Result

| Total time per Entity / Process | Actual Performance (minutes) | Scenario 1 (minutes) | Scenario 2 (minutes) | Scenario 3 (minutes) |
|---|---|---|---|---|
| Picking Process | 56.08 | 17.81 | 27.05 | 18.02 |
| Packing Process | 67.18 | 19.57 | 22.16 | 17.03 |
| Print Customer Detail | 63.47 | 13.55 | - | - |
| Automatic System | - | - | | |
| Automatic Printing | | | 0.26 | 0.26 |
| Automatic Pasting | | | 0.08 | 0.08 |
| RFID Scanner | | | 0.01 | 0.01 |
| Arrange Parcel at WA | 7.48 | 7.83 | 7.70 | 8.32 |
| Courrier Pickup | 143.89 | 195.46 | 185.89 | 201.77 |

**Table 5.** Activity Queue Result

| Activity Queue | Actual Performance (minutes) | Scenario 1 (minutes) | Scenario 2 (minutes) | Scenario 3 (minutes) |
|---|---|---|---|---|
| Picking and Scanning | 38.57 | 0.06 | 9.29 | 0.11 |
| Packing | 53.49 | 3.39 | 5.30 | 0.17 |
| Print Customer Detail | 53.42 | 3.40 | - | - |
| Automatic System | - | - | | |
| Automatic Printing | | | 0.01 | 0.01 |
| Automatic Pasting | | | 0.00 | 0.00 |
| RFID Scanner | | | 0.00 | 0.00 |
| Courier Pickup | 131.84 | 184.00 | 174.83 | 191.10 |

### Discussion

Table 4 compares the processing time taken per entity on actual performance with the three simulation scenarios run. Overall, the actual performance receives the highest result in each process performed. Meanwhile, Scenario 3 yielded the lowest result when compared to the other simulations. A significant comparison can be found in the packing process, where the actual performance obtained 67.18 minutes, while Scenario 3 only requires 17.03 minutes for processes per entity on actual performance. This is due to the fact that the time required to process each entity is closely related to the smoothness of the process. As a result, the shorter the time required for a process, the more efficient the workflow.

Table 5 described how long the queue is in each activity performed on the actual performance and the three simulated scenarios. This queue is created when an entity is unable to continue an activity due to a lack of resources, resulting in the activity requiring a place to wait. So, based on Table 3, the queue time encountered in the picking and packing activity decreases sharply when employees are added to the activity. However, in Scenario 2, the waiting time for each activity is reduced due to the presence of the automatic system on the new warehouse layout. As shown in the table, the activity automatic system is more effective and there is no queuing time when compared to the print and paste activities performed by employees from the previous packing station, which required 3.40 minutes of queuing time. As an outcome of using automatic systems, packing station employees can devote their full energy and focus to the packing process without having to worry about the next process, which is fully automated. Furthermore, the time required for printing, pasting, and quantity checking will be reduced, faster, and more accurate with the use of automatic systems.

## CONCLUSION AND RECOMMENDATION

As a result, the company's management must make swift decisions in order to overcome losses. Further issues will develop if the manager responsible for the company's performance lacks the necessary skills. For example, a lack of workforce during the festive season, combined with a lack of automation machines in the warehouse, will increase the risk of queuing time.

If the management selects the method used in Scenario 1, the company under study will just have to pay the additional workers' salaries. For example, if there are 12 employees totalling RM90 per day, the business must bear a cost of up to RM1,080 per day. But, in order for this strategy to have a greater impact, the manager of this company must play a vital part in ensuring that all employees remain active and passionate while performing their duties. This is because managers must understand that every employee has physical and mental limitations. If the warehouse manager does not take care of these two factors, this system will not continue long. As a result, to ensure that the matter does not go to waste, establishing a close relationship with employees is needed. This includes spending time together during breaks or offering them prizes as a symbol of appreciation, which is one of the things that the manager of the company may do to maintain their mental and physical health.

Meanwhile, Scenario 2 has a higher cost than Scenario 1. This is due to the fact that the automation machine employed in Scenario 2 costs between RM15k and RM17k. It is roughly the cost that Scenario 1 must issue for 15 working days. Although the cost that company must issue is large if paid all at once. With a manager's strong profit forecasting skills, the cost will not be an impediment in the effort to improve workflow performance and become more efficient. The expense of the automation machine will be well repaid by the earnings later on if proper forecasting is done by an experienced manager. Furthermore, because of the machine's processing speed, it can further reduce the time required to complete the customer's order without requiring a large amount of labour, as in Scenario 1. But, if the automation machine breaks down unexpectedly, the company will have to re-implement the original workflow.

Lastly, Scenario 3 is the most efficient technique, but it is more expensive than Scenario 1 and 2. In this situation, the corporation must incur costs for two reasons: altering the warehouse layout to fit the automated system and paying the salaries of new staff. Scenario 3 offered the best overall results because each current activity and certain extra activities (automated machine) completed had a substantial impact on activity by lowering queuing time.

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## REFERENCES

Ackerman, K. (2015). *Ethics in logistics come down to a matter of trust*. Multi Briefs: Exclusive. https://exclusive.multibriefs.com/content/ethics-in-logistics-come-down-to-a-matter-of-trust/distribution-warehousing

Amelia, P., Lathifah, A., Haq, M. D., Reimann, C. L., & Setiawan, Y. (2021). Optimising Outpatient Pharmacy Staffing to Minimise Patients Queue Time using Discrete Event Simulation. *Journal of Information Systems Engineering and Business Intelligence*, *7*(2), 102. https://doi.org/10.20473/jisebi.7.2.102-111

Bjørgen, A., Bjerkan, K. Y., & Hjelkrem, O. A. (2019). E-groceries: Sustainable last mile distribution in city planning. *Research in Transportation Economics*, *December*, 100805. https://doi.org/10.1016/j.retrec.2019.100805

Chen, F., & Li, H. (2021). *The Impact of "11.11 Shopping Festival" on E-Commerce and Traditional Industries*. 574–577. https://doi.org/10.1109/ICNISC54316.2021.00109

Colson, G., & Dorigo, F. (2004). A public warehouses selection support system. *European Journal of Operational Research*, *153*(2), 332–349. https://doi.org/10.1016/S0377-2217(03)00156-5

Dias, A. S. M. E., Antunes, R. M. G., Abreu, A., Anes, V., Navas, H. V. G., Morgado, T., & Calado, J. M. F. (2022). Utilization of the Arena simulation software and Lean improvements in the management of metal surface treatment processes. *Procedia Computer Science*, *204*(2021), 140–147. https://doi.org/10.1016/j.procs.2022.08.017

Edmonds, J. (2021). *Supply Chain Issues: Poor On-Time Delivery Performance*. Orkestra. https://blog.orkestrascs.com/supply-chain-issues-poor-on-time-delivery-performance

Elfriede, K., Hans, M., Viara, P., & Martiji, S. (2005). *Performance Indicators in Logistics Service Provision and Warehouse Management - A literature review and Framework*. *May*.

Ethical Advocate. (2020). *Dangerous Ethics Problems in Warehouses*. Ethical Advocate. https://www.ethicaladvocate.com/dangerous-ethics-problems-in-warehouses/

Kasim, A. S. A., Bareduan, S. A., Masood, I., Ho, F. H., & Abdullah, H. (2021). Capacity Study Of A Food Processing Company Using Arena Simulation Software. *Research Progress in Mechanical and Manufacturing Engineering*, *2*(1), 166–173.

Kumar, S., Narkhede, B. E., & Jain, K. (2021). Revisiting the warehouse research through an evolutionary lens: a review from 1990 to 2019. *International Journal of Production Research*, *59*(11), 3470–3492. https://doi.org/10.1080/00207543.2020.1867923

Liviu, I., Crisan, E., & Ana-Maria, T. (2009). *Warehouse performance measurement-A case study*. *May*. https://www.researchgate.net/publication/46533440

Öz, H. H., & Özyörük, B. (2021). Performance measurement in-fourth party reverse logistics. *Measuring Business Excellence*. https://doi.org/10.1108/MBE-05-2019-0048/FULL/XML

Phyllis, C. (2021). Determination of Performance Indicators for Warehouse Evaluation: A Case of Medium Sized Warehouses in Nakuru Town. *Journal of Procurement & Supply Chain*, *5*(2), 32–38. https://doi.org/10.53819/81018102T5034

Reid, H. (2020). *5 Warehouse Management Problems and How to solve them*. DCL Logistics. https://dclcorp.com/blog/fulfillment/warehouse-management-problems/

Sarma, S. (2020). *Ethics in Management: Different Approaches, Types and Benefits*. Making Business Matter. https://www.makingbusinessmatter.co.uk/ethics-in-management/

Solistica. (2019). 10 challenges of warehouse management. In *2019*. https://blog.solistica.com/en/10-challenges-of-warehouse-management

Xie, J., & Wang, L. (2021). Collaborative innovation of E-Commerce enterprises based on FPGA and convolutional neural network. *Microprocessors and Microsystems*, *80*, 103595. https://doi.org/10.1016/j.micpro.2020.103595

Yemane, A., Abrha, H., & Gidey, K. (2021). Performance Measurement and Improvement of Healthcare Service Using Discrete Event Simulation in Bahir Dar Clinic. *Journal of Optimization in Industrial Engineering*, *14*(2), 41–51. https://doi.org/10.22094/JOIE.2020.1870857.1662

Yin, C., & Mckay, A. (2018). *Introduction to Modeling and Simulation Techniques*. https://www.researchgate.net/publication/332962311_Introduction_to_Modeling_and_Simulation_Techniques

## CONFLICT OF INTEREST

The author(s), as noted, certify that they have NO affiliations with or involvement in any organisation or agency with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, jobs, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, expertise or beliefs) in the subject matter or materials addressed in this manuscript.

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