



LOGISTICS ARENA COMPETITION 2024

# THREE LEAVES AUTOMATION WAREHOUSE

BELIEVERS



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# EXECUTIVE SUMMARY



## SITUATION

Three Leaves, a leading global sportswear brand, is looking to expand its market in Vietnam and plans to establish a new distribution center that will serve online individual customers directly.

## COMPLICATION

- Three Leaves is considering which option to choose for the operations of the distribution center: Option 1 (Manual) and Option 2 (Semi auto)
- Super sales day and weekend days (60% sales volume) causes challenges of capacity

## QUESTION

Q1: Which operations option to choose for the DC?

Q2: How to meet the demand of peak sales day?

Q3: What are the solutions to improve the chosen option?

## STRATEGY

### ORDER - FULFILLMENT FOCUSED STRATEGY

## SOLUTION

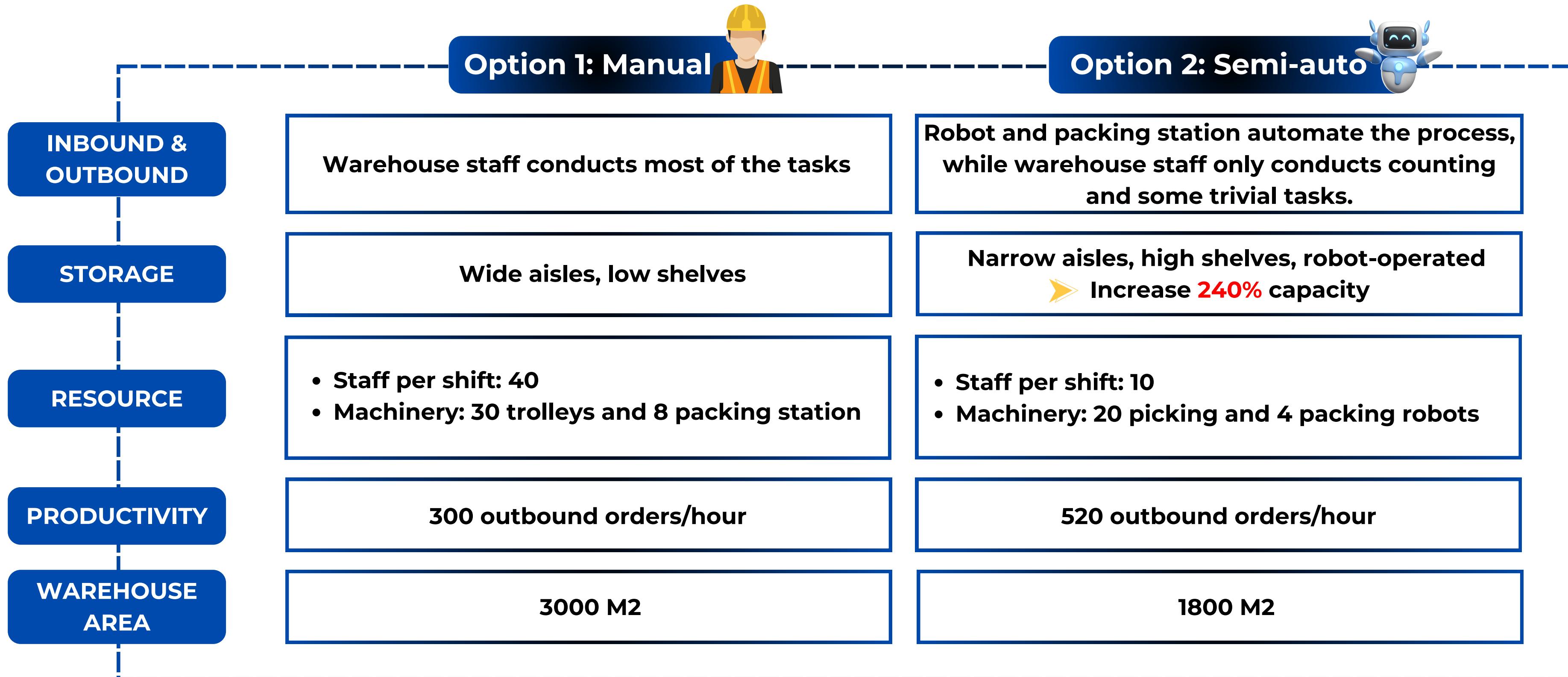
Pre-order policy +  
Collab with central  
warehouse

Mix-I-shaped DC  
layout

Flexible labor force  
+ Order picking  
robots

# OPERATION OPTIONS

THE PROBLEM IS TO DECIDE WHICH OPTION THREE LEAVES SHOULD GO FOR





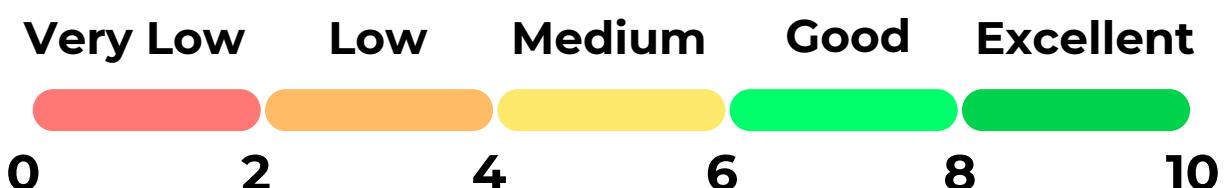
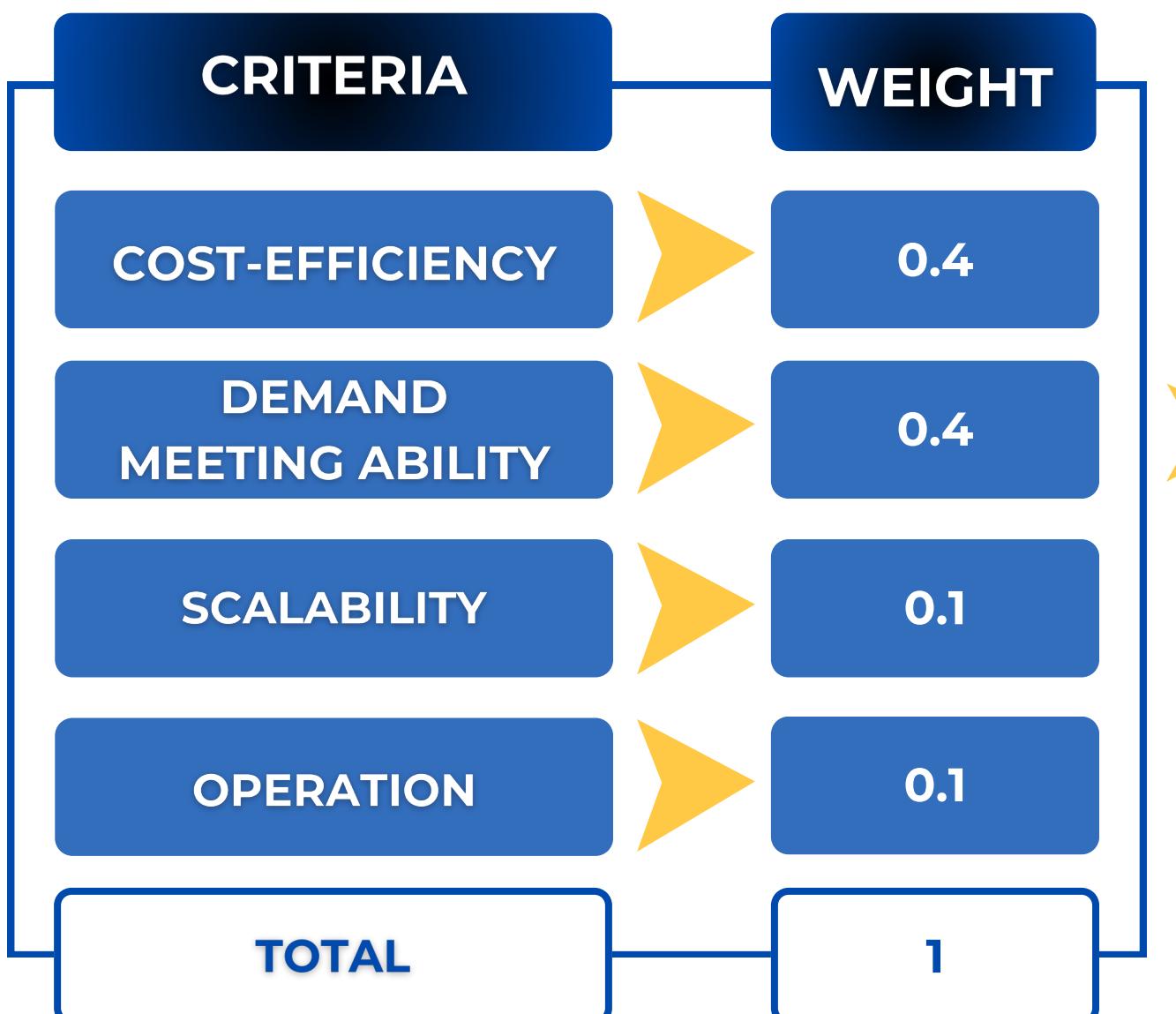
# ANALYSIS

# DECISION SUPPORT SYSTEM

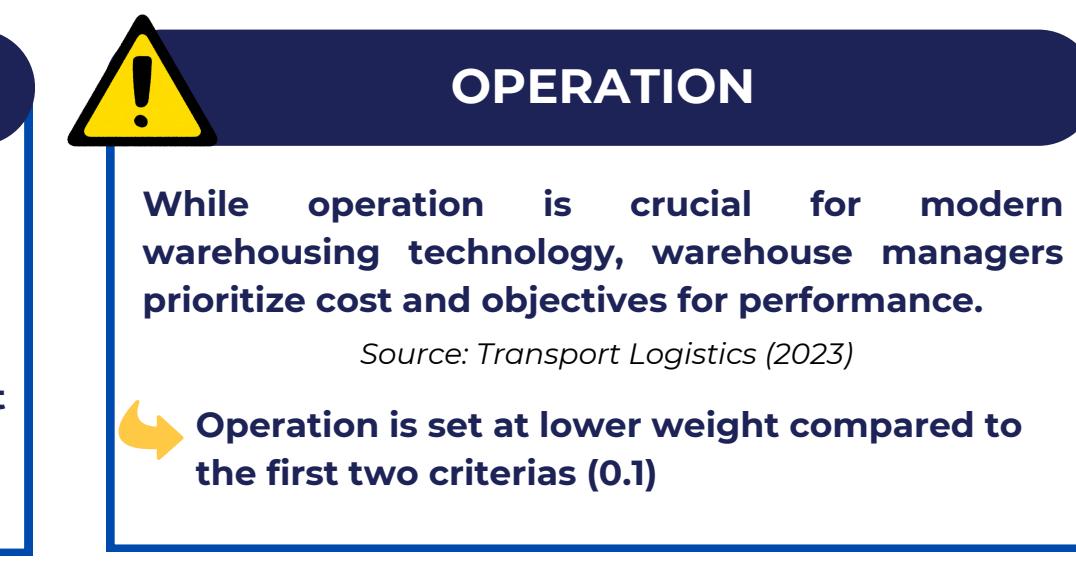
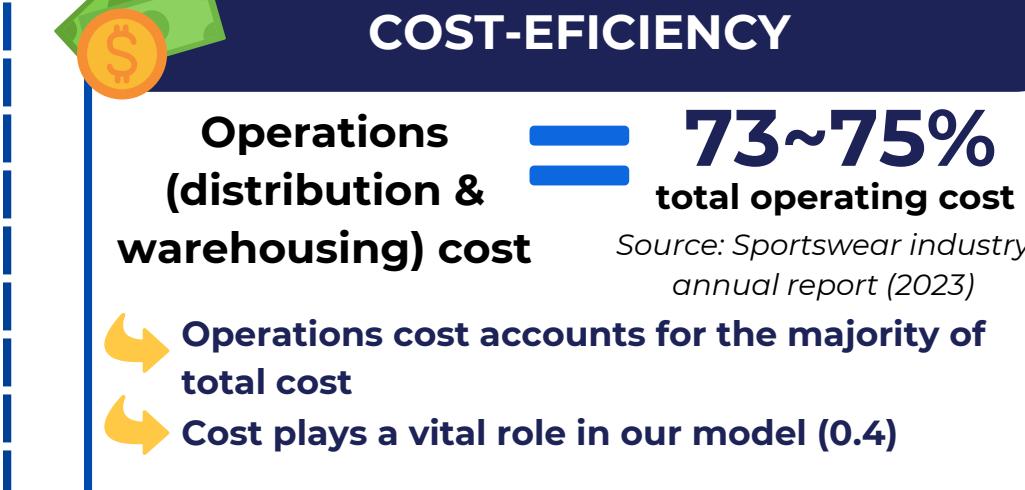
DECISION SUPPORT SYSTEM IS USED TO DECIDE WHETHER OPTION 1 OR OPTION 2 WILL FIT US



DSS includes the **criterias** with their corresponding **weight** of importance and the **rating scale** from 1-10 for each criteria.



## CRITERIAS AND WHY WE WEIGH THEM THAT MUCH



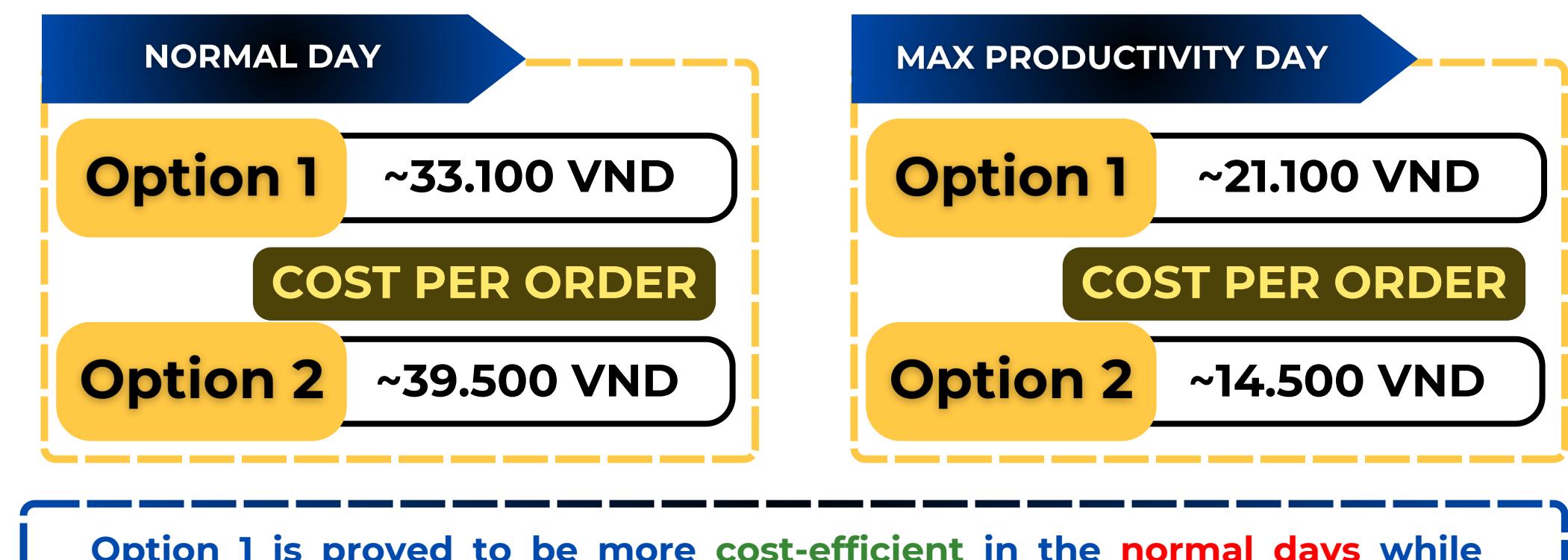
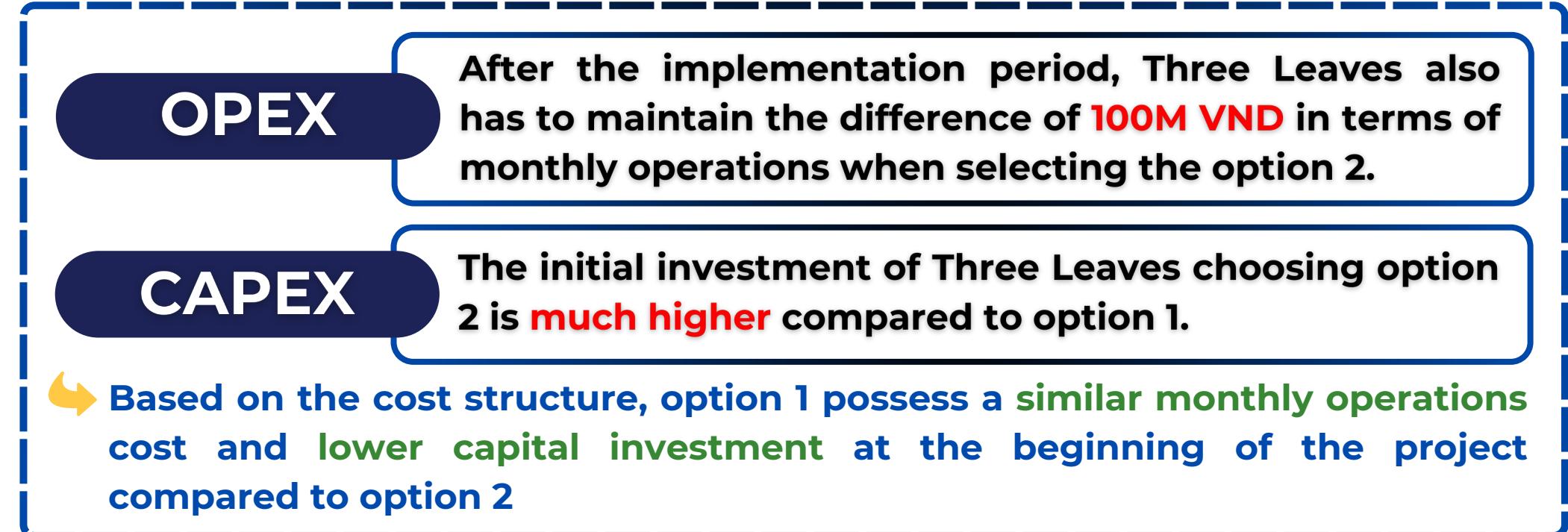
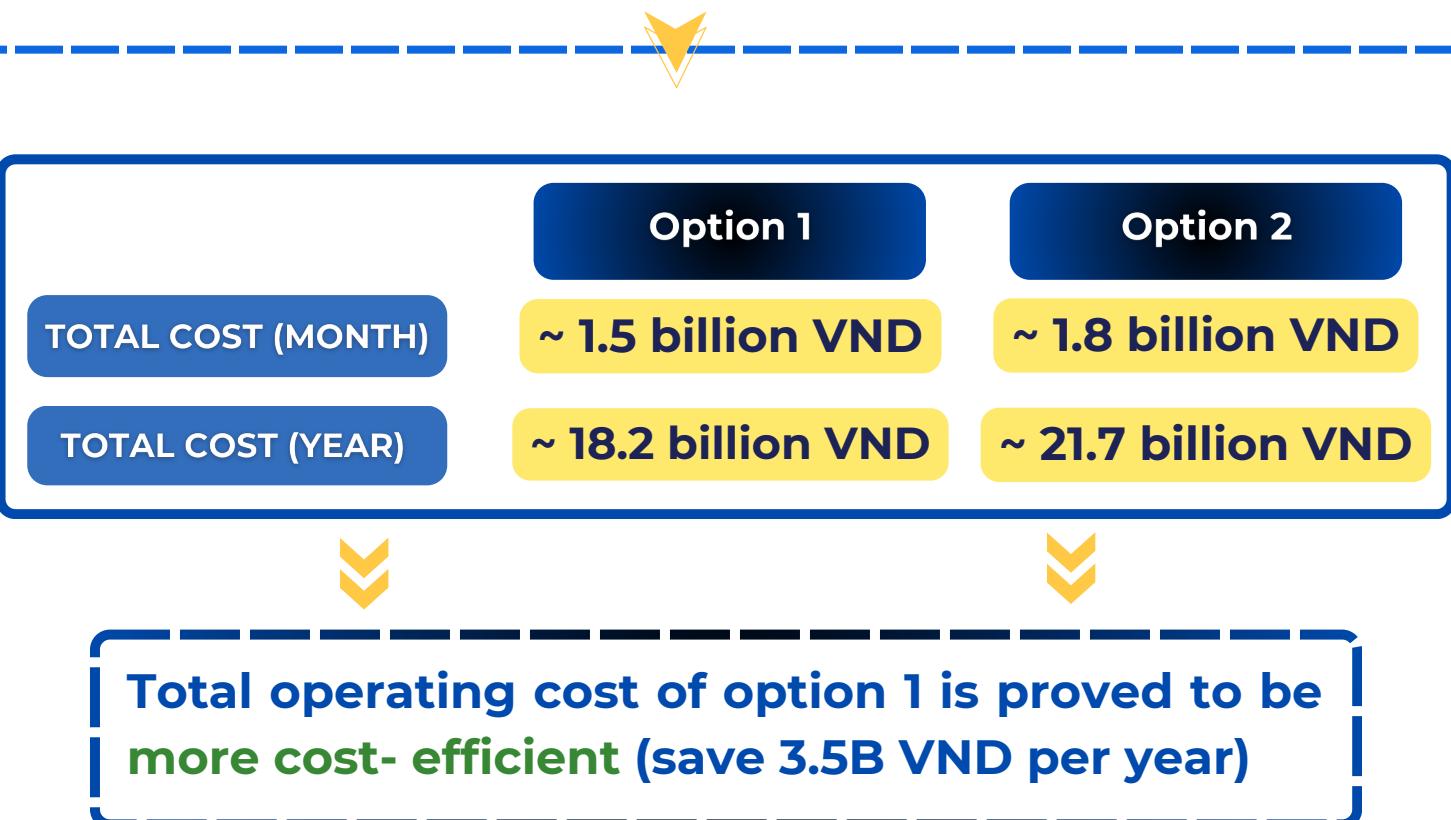
Based on the criteria and their corresponding weights, the Decision Support System (DSS) will enable Three Leaves to calculate a total score for each alternative, thereby allowing the selection of the most suitable option.

# COST-EFFICIENCY

	Cost structure (VND)	Option 1	Option 2
Variable cost	Labor costs/month	480,0 M	120,0 M
	Electricity cost/shift	600,0 M	1.050,0 M
	Warehouse rental cost m2/month	315,0 M	189,0 M
	Warranty cost/month	14,8 M	75,6 M
	Other cost/month	30,0 M	45,0 M
	OPEX (month)	1,4 B	1,5 B

	Cost structure (VND)	Option 1	Option 2
Fixed cost	Shelf installation cost	39,3 M	58,9 M
	Robot investment cost	0,0 M	166,7 M
	Packing station investment cost	4,0 M	53,3 M
	IT system investment cost	36,7 M	50,0 M
	Other investment cost	1,7 M	3,3 M
	CAPEX (month)	81,6 M	332,3 M



Year	1	2	3	4	5
Total cost (Option 1)	18.256.429	36.512.857	54.769.286	73.025.714	91.282.143
Total cost (Option 2)	21.742.643	43.485.286	65.227.929	86.970.571	108.713.214

Through the 5-year period, the operating cost of option 2 will be always higher than option 1

## INITIAL INVESTMENT COST



- The initial investment of option 2 is **4 times** higher than option 1
- Three Leaves will lose the opportunity cost of utilizing capital

## ROBOT INVESTMENT



- After 5 years, the initial robot investment depreciates down to **zero**
- Three Leaves shall reinvest in this case

Option 1 is solidly cost-efficient with lower operating costs and with a low level of initial investment  
Option 2 tends to be more costly while may possess advantages in terms of other criterias

**Total point**

Option 1	9
Option 2	6

# DEMAND FULFILLMENT ABILITY

**300 outbound orders/hour**

**Option 1**

**Option 2**

**520 outbound orders/hour**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Inbound	111,090	98,700	123,200	98,520	119,660	106,770	108,280	110,010	118,610	128,330	129,720	152,870
Outbound	56,937	47,324	73,881	40,331	72,629	55,181	52,771	62,802	60,783	46,400	83,031	95,745
Inventory	168,027	146,024	197,081	138,851	192,289	161,951	161,051	172,812	179,393	174,730	212,751	248,615
Monthly order	56,937	47,324	73,881	40,331	72,629	55,181	52,771	62,802	60,783	46,400	83,031	95,745

**Mar & May**

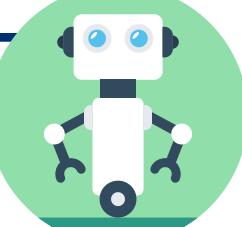
**Sports season begins**

**Picking productivity**

**Human**  
**10** outbound order/hour



**Robot**  
**26** outbound order/hour

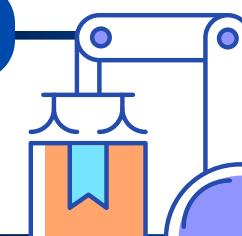


**Packing productivity**

**Packing station**  
**38** outbound order/hour



**Automatic packing robot**  
**130** outbound order/hour



Mar, May, Nov and Dec have a significant increase in sales and order

**Nov & Dec**

- ➡ Christmas
- ➡ Tet
- ➡ Cyber Monday (first Monday after Black Friday)
- ➡ Black Friday (Friday of the 4th week of November)

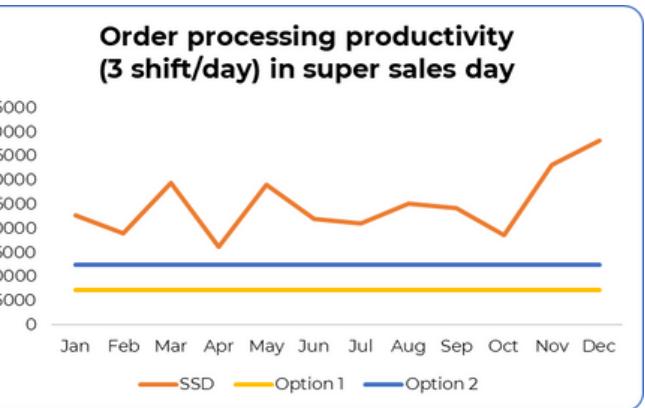
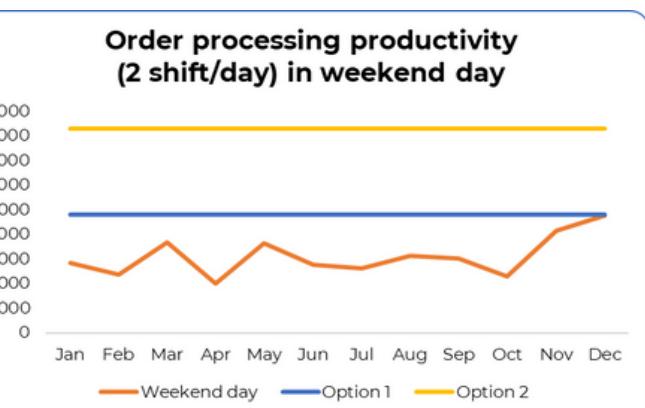
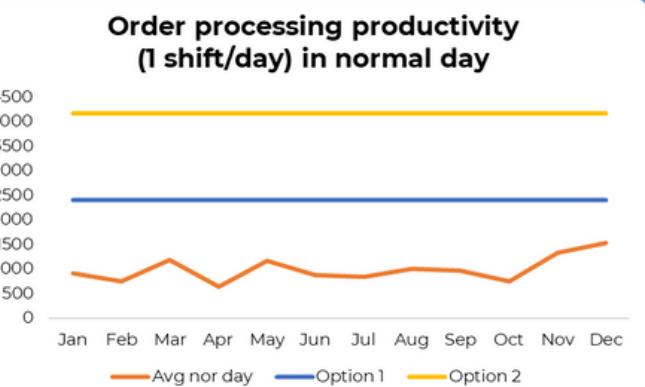
Three Leaves must deal with the surging demand in certain months.

The productivity of option 2 is proved to be more efficient in terms of order picking and packing.

# DEMAND FULFILLMENT ABILITY

## Assumption

1 shift = 8 hours



Total point

Option 1

6

Option 2

8



During the normal day, both options tend to fulfill the demand of order packing with only 1 shift per day



## Option 1

Low order fulfillment capability that only works in normal days' demand and struggle with weekend days and Super Sales Day

## Option 2

Higher order fulfillment capability that can comfortably deal with normal days and weekend days while also having problems with Super Sales Day

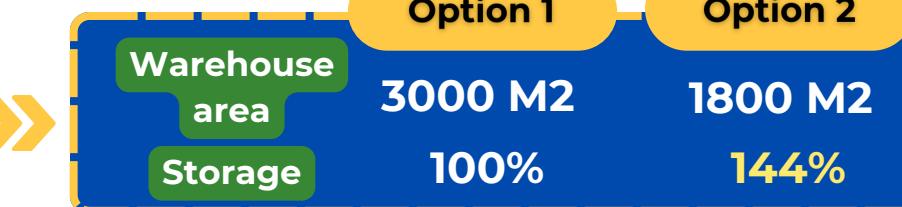
### Storage capacity

Option 2

= 340%

Option 1

with same area



### Option 1

#### Storage & aisle

= 50% Warehouse area

1500 M2

3000 M2

Source: Warehouse and Distribution Science (2019)

REACH

2-3 m

Storage

Storage

1500 M2

1000 M2

Source: Rdsic

2200M3

Category	Max piece capacity	Max monthly piece quantity
Footwear	119,884	54,270
Apparel	338,182	75,670
Hardware	115,420	33,270

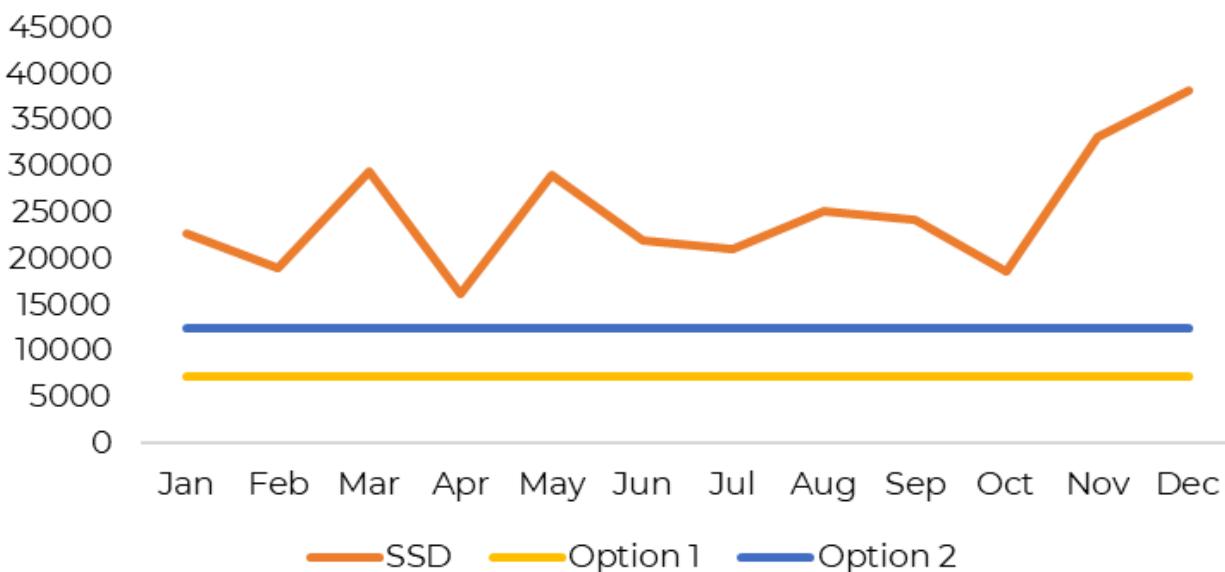
Option 1's storage capacity is enough to deal with average inventory day

Option 2's storage can function the same

Three Leaves should only focus on Super Sales Day



## Order processing productivity (3 shift/day) in super sales day



- Option 1 must significantly scale up to meet peak demand, particularly on weekends and during Super Sales Day
- Option 2 requires less capacity expansion to handle fluctuating demand compared to Option 1 (for Super Sales Day only)

Option 1

Option 2

Capacity

2/5

3/5

Ease of expansion

2.5/5

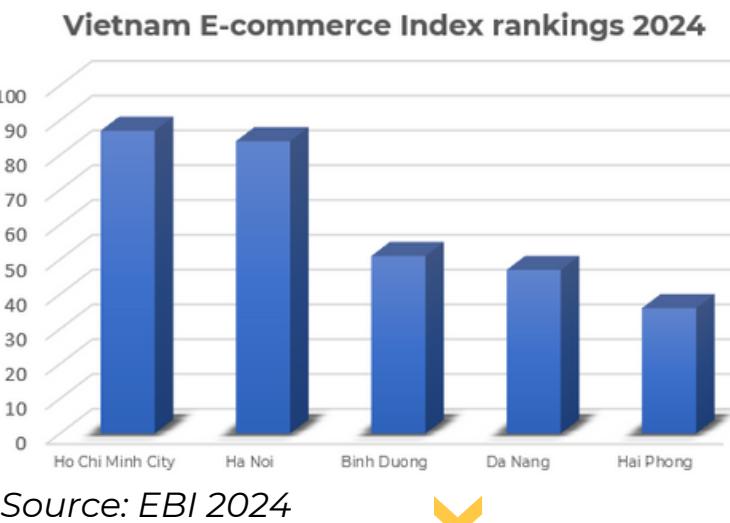
4/5

Total point

4.5

7

## Horizontal expansion



As Ho Chi Minh City accounts for the majority of E-commerce sales, the DC is likely to be located in the Industrial Zones in HCM City.

Industrial land rents to rise **7-9%** per year Source: Vietnam Economics Times

Horizontal expansion in Industrial Zones (Expanding the DC's area) is challenging due to high land rental costs and shortage of space

## Vertical expansion

Increasing the height of the shelves complicates warehouse operations, as staff must use ladders to access goods, limiting reach and increasing accident risks.

OPTION 1

OPTION 2

More feasible, has a smaller area but higher shelves than the 1st, allowing the robot to pick up goods without limitation.

REACH



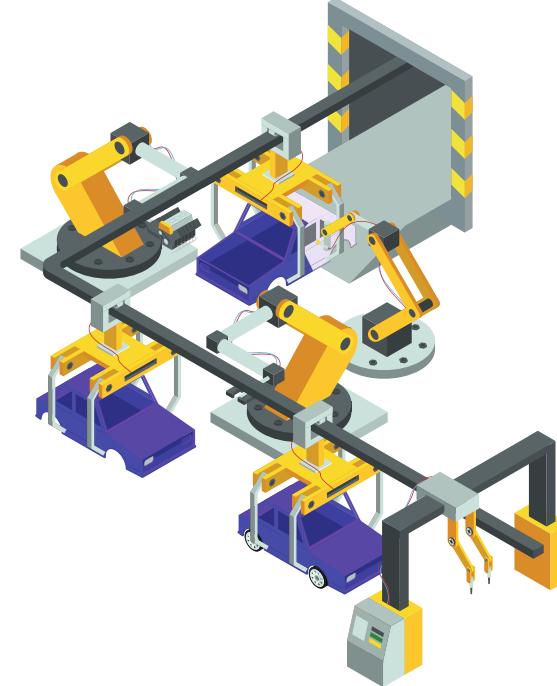
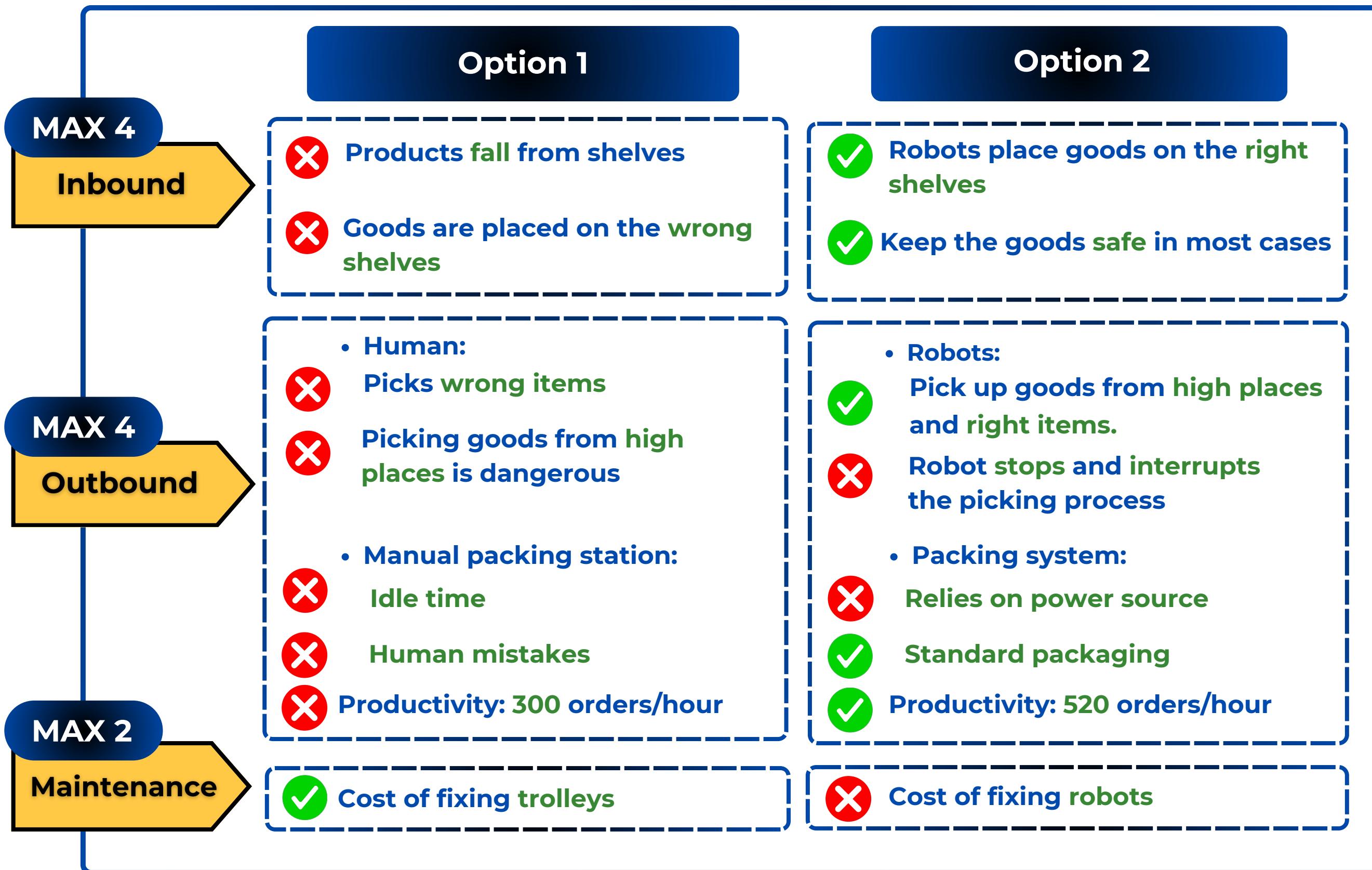
2-3 m



4-5 m



6-7 m



Based on the above analysis, we have graded two options according to the following table

	Option 1	Option 2
Inbound	2/4	3.5/4
Outbound	2/4	3.5/4
Maintenance	2/2	0.5/2
<b>Total point</b>	<b>6</b>	<b>7.5</b>

# OPTION CHOICE

FOLLOWING THE DECISION SUPPORT SYSTEM, THE RESULTS ARE SYNTHESIZED IN THE TABLE BELOW



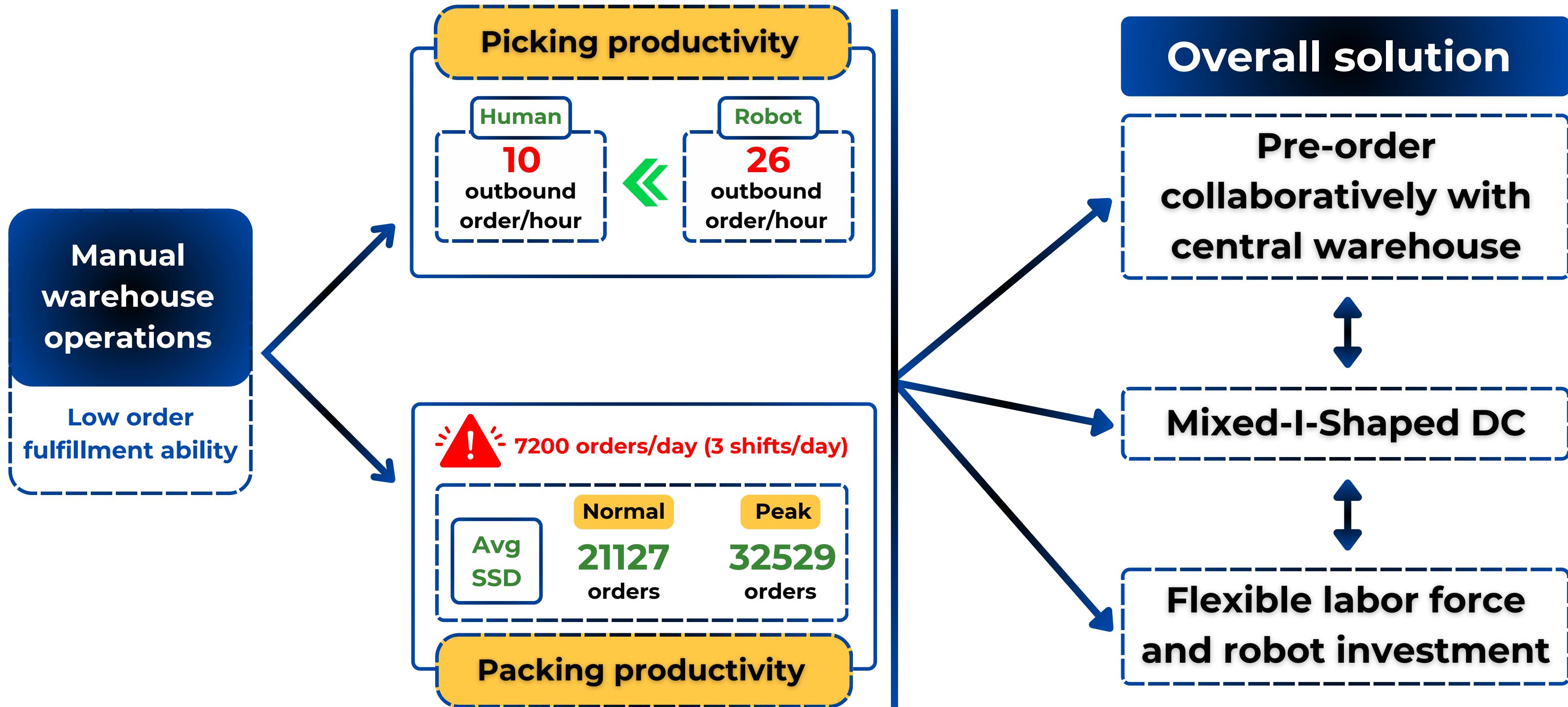
CRITERIA	WEIGHT	OPTION 1	OPTION 2
COST- EFFICIENCY	0.4	9	6
DEMAND MEETING ABILITY	0.4	6	8
SCALABILITY	0.1	4.5	7
OPERATION	0.1	6	7.5
TOTAL	1	7.05	6.65

Based on the total higher score,  
Three Leaves should go for option 1

# RECOMMENDATION

# PROBLEMS - SOLUTIONS

ONTO THE IMPLEMENTATION OF THE CHOSEN OPTION, WE FOCUS ON ADDRESS THE KEY CHALLENGE OF OPTION 1



Three Leaves can achieve more accuracy and apply the seasonality in demand forecast by using seasonal index

Seasonal index	Jan	Feb	Mar	Apr	May	Jun
	0.914	0.759	1.186	0.647	1.165	0.885
	Jul	Aug	Sep	Oct	Nov	Dec
	0.847	1.008	0.975	0.745	1.332	1.536

Demand forecast Python code using seasonal index

```
import pandas as pd

# Given 2024 monthly order data
monthly_orders_2024 = [56937, 47324, 73881, 40331, 72629, 55181, 52771, 62882, 60783, 46400, 83031, 95745]

# Calculate the monthly average for 2024
monthly_avg_2024 = sum(monthly_orders_2024) / len(monthly_orders_2024)

# Calculate the seasonal index for each month based on the 2024 data
seasonal_indices = [order / monthly_avg_2024 for order in monthly_orders_2024]

# Given CAGR
cagr = 4.8 / 100 # Convert to decimal

# Calculate the projected average for 2025
monthly_avg_2025 = monthly_avg_2024 * (1 + cagr)

# Calculate the 2025 forecast for each month
monthly_orders_2025 = [monthly_avg_2025 * si for si in seasonal_indices]

# Create a DataFrame to display the results
data = {
    "Month": range(1, 13),
    "2024 Orders": monthly_orders_2024,
    "Seasonal Index": seasonal_indices,
    "2025 Forecasted Orders": monthly_orders_2025
}
df_forecast = pd.DataFrame(data)

# Display the DataFrame
print(df_forecast)
```



CAGR

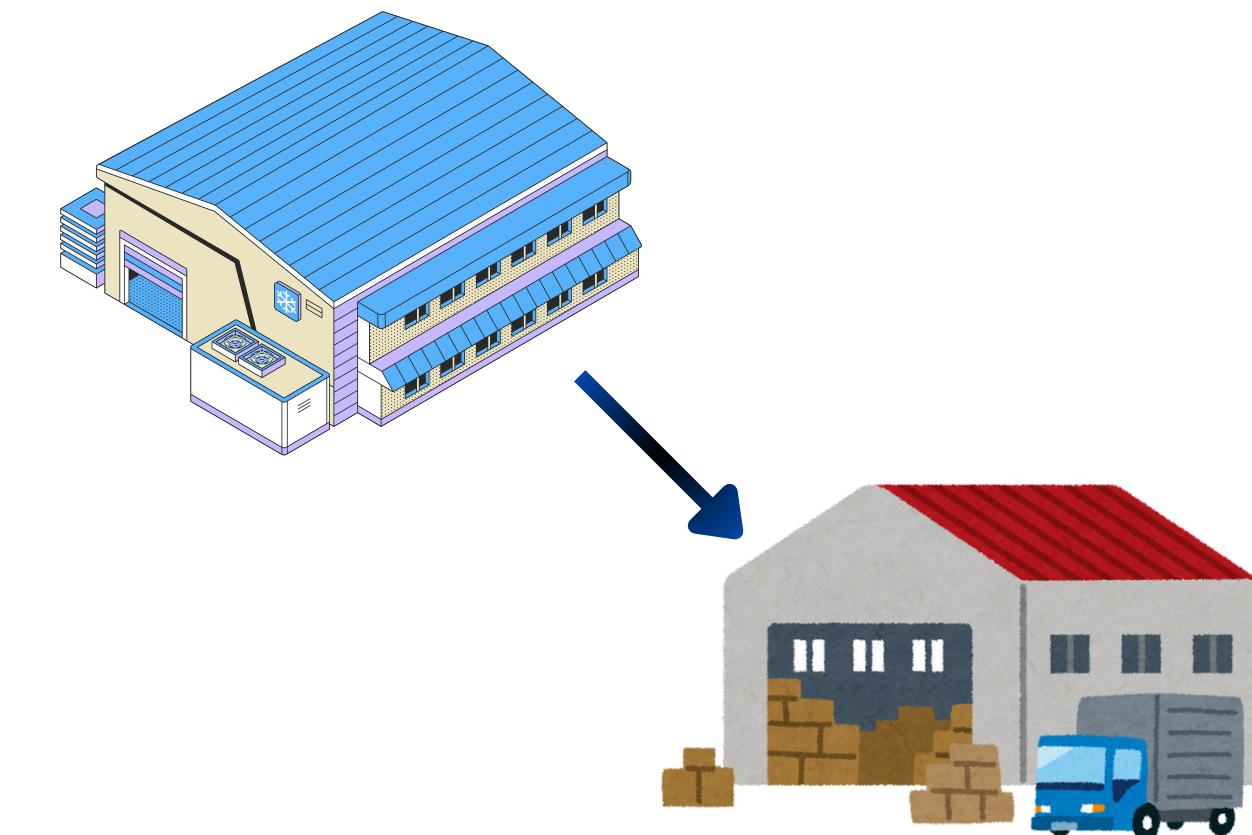
4.8%

### Three Leaves' monthly order 2025F



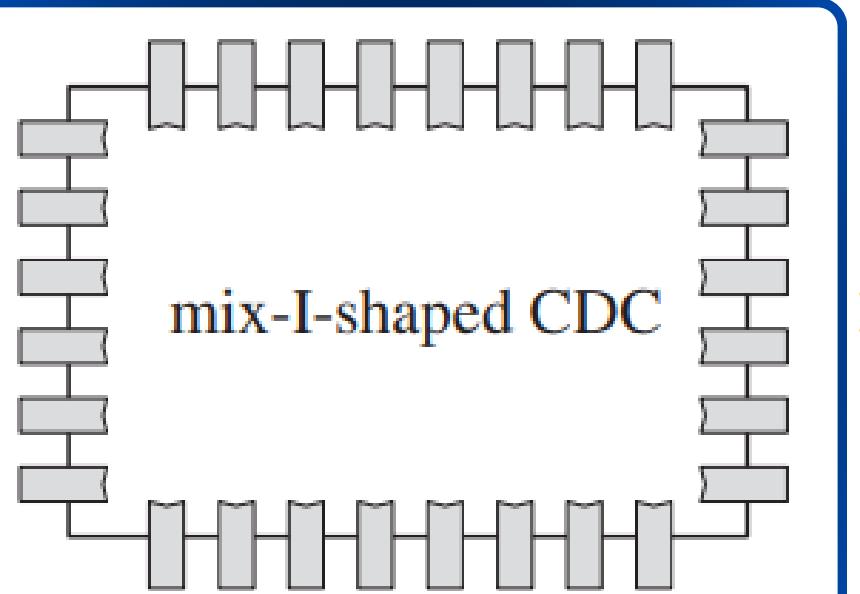
- ➡ Increase accuracy by 10 - 25 %
- ➡ Suitable order quantity for the DC

Three Leaves distribution centres can negotiate with the central warehouse to pre-order the categories based on the demand forecast of Super Sales Day



- ➡ Possess the inventory to fulfill in Super Sales Day
- ➡ Reduce the risk of lost sales

## Mix-I-shaped layout



Mix-I-shaped warehouse layout possesses a huge amount of docks which are flexible to be used as inbound or outbound area

### Strategy

Normal days

The number of inbound and outbound dock are equal

Pre-SSD

Prioritize docks as inbound area

► Fully utilize the docks to receive inbound shipment from central warehouse

During SSD

Prioritize docks as outbound area

► Fully utilize the docks to process outbound shipment to maintain high service level

## Pre-order inventory

Pre SSD  
Must maintain a higher inventory level  
Season  
Normal ~ 4225 pieces/day  
Peak ~ 6505 pieces/day

% Additional Storage Volume  
**232.13%**

Source: IOP Conference Series: Materials Science and Engineering



► Implement Mezzanine racking system

### Strategy



ITL customized solutions with the flexible storage integrated with WMS System

**300,000 m<sup>2</sup>**  
of international standard warehousing space

► Suits the needs of temporary inventory  
► Ensure the availability of products for packaging

# SOLUTION 3

FLEXIBLE LABOR FORCE ALONG WITH USING ROBOTS



## On Super Sales Day

### Picking

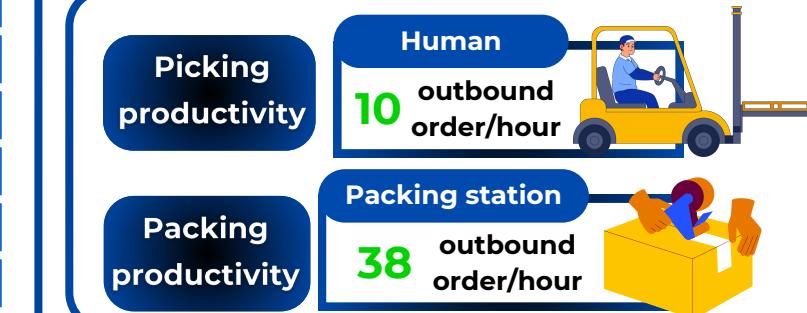
- Hire 30 staffs for 1-2 pieces/order ➤ Cost: 1.5M/h
- Buy 3 automatic picking robot for >2 pieces/order ➤ Cost: 1.5B

### Packing

- Hire 10 staffs ➤ Cost: 500k/h
- Buy 10 packing stations ➤ Cost: 300M

Increase 125% productivity in outbound orders

## Why we choose human



Average Piece/Order 1.89

➤ The current productivity of human labor is not enough to deal with Super Sales Day

➤ Implement overtime+part-time employees in the peak period

➤ Hiring human is more economic

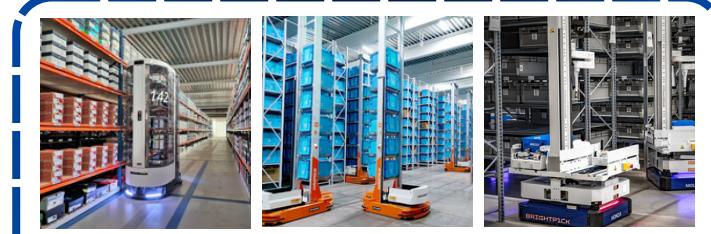
## Why we choose robot

30%

Customers tend to shop more on E-Commerce platforms during peak seasons  
Source: KiotViet

More pieces/order in SSD

- Human labor cannot maintain the productivity the order picking of multiples products
- Three Leaves shall invest in 1 robot for each kind of products



Footwear Apparel Hardware

## LIMITS OF COORDINATION BETWEEN HUMANS AND ROBOTS

Coordinating work between robots and employees in limited spaces is challenging, as robot movement in tight areas can disrupt employee activities

1



## IMPROVEMENT

Arrange routes for robots and employees

Investing in more flexible robots (like AMR) can also help robots operate effectively

## HUMAN MISTAKES

- Human errors in picking up goods (pick wrong items, missing items as human errors in the picking process)
- Human errors in the packing process (wrong labels, don't apply tape tightly) will cause damage to the goods

2



## IMPROVEMENT

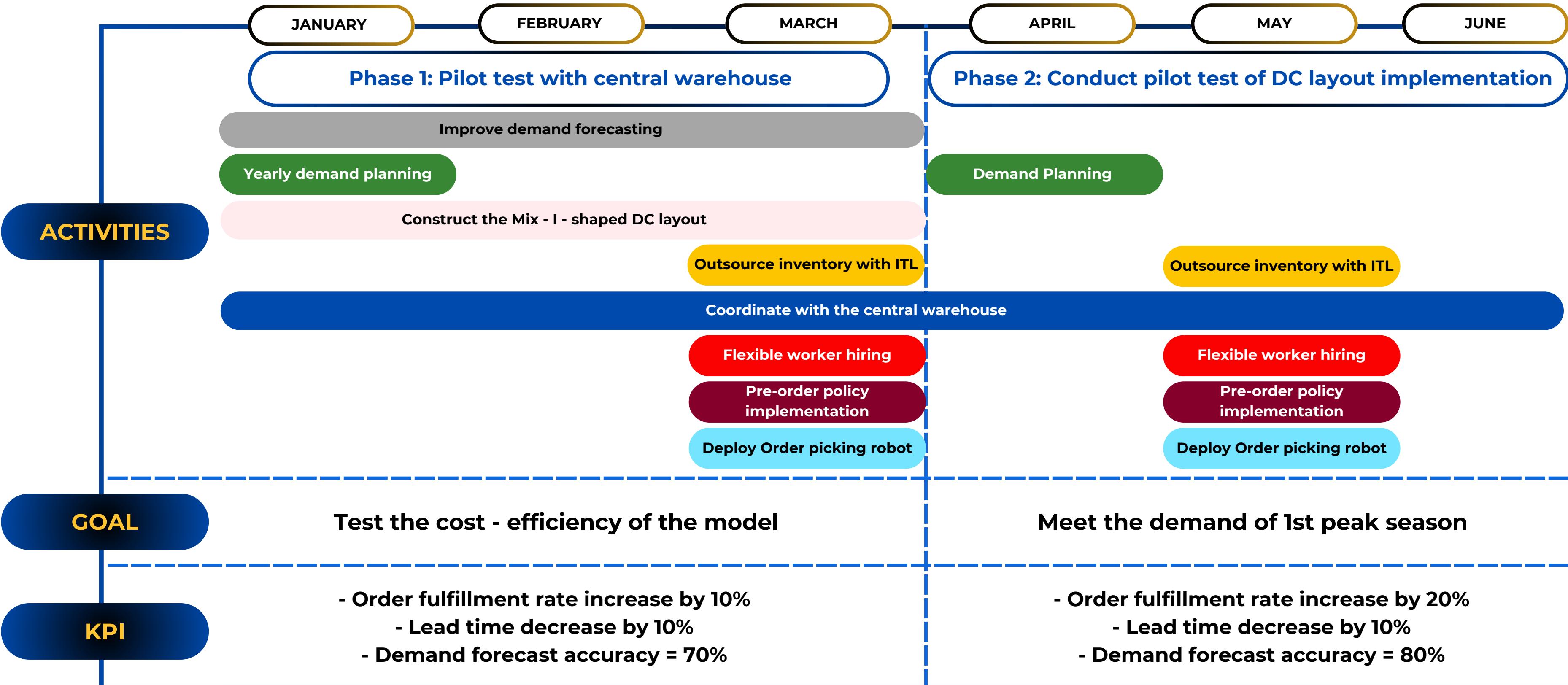
Develop clear, detailed and easy-to-implement standard packaging procedures (Standard Operating Procedures - SOP)

Use a monitoring system to monitor the operation process and detect errors promptly

# EXECUTION TIMELINE



# EXECUTION TIMELINE



# EXECUTION TIMELINE



JULY AUGUST SEPTEMBER OCTOBER NOVEMBER DECEMBER

## Phase 3: Cost and operations optimization + reflection

## Phase 4: Max internal and external capacity utilization

Peak season demand planning

### ACTIVITIES

Coordinate with the central warehouse

Pre-order policy implementation

Outsource inventory with ITL

Overtime + Flexible worker hiring

Deploy Order picking robot

### GOAL

Minimize the complexity of operations and cost optimization

Meet the demand of peak season sales

### KPI

- Operations number of steps decrease by 20%
- Order fulfillment rate increase by 15%
- Demand forecast accuracy = 90%

- Maintain service level = 95% -100%
- Backorder = 0% - 5%
- Demand forecast accuracy = 90%



# RISK MANAGEMENT

## ACTIVITIES

## NO

## RISK

## SOLUTION

Improve demand forecasting and plan in advance

R1

**Inaccurate demand forecasting for major sales events**

Accurately forecast demand for upcoming Super Sales Days

R2

**Stock shortages or excess inventory during major events**

Coordinate with the central warehouse

R3

**Products not available in time for large orders**

Store inventory 4-5 days in advance

R4

**High storage and inventory management costs**

Outsource a portion of large inventory to ITL's warehouse service

R5

**Dependence on partner service quality and reliability**

Apply flexible workforce management

R6

**Labor shortages during sudden demand spikes or increased costs from using more staff than necessary**

Increase the number of order-picking robots

R7

**High investment costs and potential technical issues.**

Redesign the DC layout with a flexible structure for inbound and outbound

R8

**High costs for redesign and potential errors in new workflow**

**Apply advanced forecasting models and integrate data from various sources to improve accuracy**

**Coordinate closely with relevant departments to plan inventory accurately**

**Establish early alert systems and workflows to stock inventory from the central warehouse in advance of major events**

**Optimize storage space at the DC, and implement flexible stocking plans to reduce costs**

**Set clear partnership agreements, establish KPIs, and regularly monitor ITL's performance**

**Establish rapid recruitment and training processes, and manage flexible work hours to meet fluctuating demands**

**Implement regular maintenance and train staff to quickly address technical issues that may arise.**

**Pilot the redesign in a small area before full implementation, gather feedback, and improve processes accordingly**

## RISK SEVERITY MATRIX

IMPACT (LOW TO HIGH)

	1	2	3	4	5
1			R6		
2				R3	
3			R8	R1,R5	R2
4			R4	R7	
5					

PROBABILITY  
(LOW TO HIGH)

## FMEA CLASSIFICATION

HIGH	2	R2,R7
MEDIUM	5	R1,R3,R4, R5,R8
LOW	1	R6



Three Leaves needs to focus resources on high-level risks to minimize their effects

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# REFERENCES



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