Original Research Article

Relocation of a warehouse for a cosmetic company: A case study

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Abstract: Warehouses are pivotal components within a company's supply chain, handling crucial functions such as receiving, storing, and delivering goods to end customers. While extensive research exists on the strategic location of warehouses in network optimization, there is a notable dearth of research on how to relocate a warehouse from one site to another, particularly while minimizing associated risks. This study sheds light on a low-risk approach undertaken by a multi-level marketing (MLM) company in Malaysia during the relocation of their warehouse. The study primarily addresses several key constraints: (i) Completion of the warehouse relocation exercise in 4.5 months; (ii) Termination of their warehouse staff services during the relocation; (iii) Elimination of disruption in the order fulfillment service level; (iv) Management of temperature-sensitive goods during the transfer and storage; (v) Seamless linkage between the third-party logistics (3PL) warehouse management system (WMS) and the company's systems. The primary objective of this study is to propose a resilient strategy for the relocation of their warehouse, taking into account these key constraints faced by the company.

Keywords: Warehouse, Operations, Relocation, Resilient, Inventory management.

1. Introduction

Relocating a warehouse is complex and time-consuming. It involves detailed planning, cost assessment, and risk management (Nagahan and Akın, 2018). Thus, effective project management is crucial to minimize stress, costs, and time overruns. Companies need competence in project management to improve supply chain processes. Different approaches, such as the Project Management Institute (PMI) approach or a more intuitive approach, can be used to enhance project management capabilities (Kuster et al., 2023). Likewise, planning is vital in the warehouse relocation process. Factors like trucking, labour, and equipment costs need to be budgeted carefully (Zapata et al., 2020). Understanding the impact on a company's culture and stakeholder expectations is essential in managing risks (Singh, 2022). On the other hand, resilience is a dynamic process involving disturbance, surprise, change, and adaptation. Managing risk through a resilience perspective requires reducing, transferring, and preparing for impact, responding efficiently, and being prepared for unexpected events. Supply chain risk management is context-specific, focusing on critical and foreseeable risks (Gurtu & Johny, 2021). Hence, effective project management is essential, and a focus on resilience can enhance risk management strategies in supply chain processes (Ageron et al., 2020).

This study will, therefore, focus on summarizing the development of a resilient approach for Company X to successfully relocate their warehouse. The primary reason for the study of a resilient warehouse relocation approach is that the consequence of a failure of warehouse relocation is very costly (Nagahan and Akın, 2018). Company X had two previous warehouse relocation project that failed and suffered serious financial losses due to interrupted services. This is driven by the fact that Company X has not relocated its warehouse for more than

Received: 15 September 2023 Accepted: 17 October 2023 Available online: 5 December 2023

20 years and none of its existing supply chain staff has any warehouse relocation experience. Relocating a warehouse will always bring changes to existing proven systems and processes and hence introduce risks (Kotonen, 2017). Therefore, this study intends to propose a new structured risk identification framework and action plans to mitigate all the identified risks (González-Hernández, 2019).

The paper is divided into six sections. It starts by briefly outlining the present Company X scenario and the major issues that arose during the relocation of the warehouse process. The current warehouse activities of Company X are covered in the section. The risk assessment and mitigation approach, results, and KPIs are presented in the following section. The conclusion will then be presented in the final section. The results of this study will offer academic scholars and business practitioner's deeper understanding of warehouse relocation strategies. Additionally, the suggested strategies will improve supply chain risk management as a whole.

2. Company X overview

Company X is one of the pioneer companies in multi-level marketing (MLM) in Malaysia with over 40 years of history. It is one of the top MLM companies in beauty, household, and personal care categories with a global annual turnover amounting to billions of US dollars and millions of sales representatives selling their products to end consumers. It operates the same business model as its parent company in the US but with a smaller range of portfolio of products which includes skincare, colour cosmetics, fragrance and personal care products to suit local demands. As a direct sales company, Company X does not have any sales staff but instead recruits thousands of agents or distributors to sell their products directly to end consumers. To support these distributors, Company X operates more than a hundred retail shops across the nation to facilitate the replenishment needs of their distributors. In addition, it also offers online stores for distributors to place their orders even after office hours.

Company X was at its peak in 2004 with its share price trading at an all-time high of USD138.80 per share. However, Company X's performance deteriorated to the point where its shares were traded at only USD 4.08 per share in late 2018, or a negative 22.26% compound annual growth rate (CAGR) over these 14 years. The fall was due to mismanagement by the previous CEO, resulting in the decline of sales, profitability and number of participating distributors. Consequently, a new CEO was hired in 2018 to turn around the company. The new CEO introduced a multi-pronged strategy that involved all levels of the company intending to improve their performance. This strategy included, (i) sharpening the product portfolio; (ii) selling unused assets; (iii) shedding global workforce; (iv) hiring new global executives, and (v) renewing the company's focus on its biggest and best-selling brand. These strategies had significant implications on the supply chain, particularly items (ii) and (iii). Given these global directives from top management to operate with more agility and efficiency, Company X in Malaysia responded by selling off its HQ building (including the warehouse) in Petaling Jaya to a new buyer and outsourced its warehouse operations to a newly appointed third-party logistics (3PL) in a new location.

Company X sought out and appointed a 3PL to manage their warehouse operations from a different site. A pressing immediate concern related to staff, in particular, is making redundant the warehouse staff who average 12 years of experience. Compliance with local labour law required Company X to serve a 2-month notice or pay in lieu when dismissing any staff. Given their tight financial situation, Company X decided to serve their warehouse staff redundancy notice prior to the warehouse relocation exercise to reduce expenses. This however created huge operational risks such as sabotage by staff in particular, absenteeism, intentional low productivity, delay of transfer plan, intentional errors in work such as picking the wrong item or quantity, damaging the goods, pilferages, etc. Additionally, local management has also set the requirement of no-service disruption to its sales agents from Monday to Friday during the move. This is to avoid a repetition of Company X's experience of two failed warehouse relocation projects with a loss of sales that ran into millions. Company X was 4.5 months into the completion of the relocation exercise when this study commenced. Thus, this study's objective is to propose a strategy for the timely and successful completion of the relocation exercise and ultimately prevent any delay in the handover of property to the new buyer the failure of which would expose Company X to legal penalties.

2.1 Issues encountered

In line with Company X's latest corporate strategies, the company decided to outsource its warehouse operations, sell off its warehouse building and retrench its warehouse operators. However, moving a warehouse is not just about transferring stocks to another warehouse. It also involves the seamless relocation and continuity of the warehouse management system (WMS) and data, which will now be operated by a new team of warehouse operators from the 3PL. Furthermore, the company has to address the additional requirements which include a completion of the warehouse relocation exercise within 4.5 months. Company X sold off its existing warehouse and as a result, needs to vacate and hand over the property in 4.5 months, failing which the company will incur costly penalties for non-compliance with the sales agreement. This means that all inventories, equipment as well and racking facilities must be cleared from the current warehouse before the cleaning up and subsequent handover of the building.

Moreover, Company X timed the last working day of the warehouse operators to coincide with their planned warehouse handover date to maximize the savings on salary expenses. Thus, the notification of redundancy of warehouse operators before the commencement of the relocation exercise should be in place. According to Malaysian Labor Law, employers must serve a notice of termination to their employees in advance or must pay in lieu of notice for the same notice period. Company X chose to serve their warehouse operators 2 months' advance notice of the redundancy following labour law. Unfortunately, this means that the staff will be notified before any stocks are transferred out to the new warehouse. There would be pressure on the company to achieve a flawless relocation exercise. The greatest threat to a flawless relocation exercise in this project is the risk for the warehouse operators who are made redundant to either sabotage operations or lower their productivity.

Additionally, Company X also expects minimal or no disruption to their order fulfilment during the transition period as Company X is in an MLM industry and high service levels to customers offer them a competitive edge. Hence, product availability is critical to the business. Since some cosmetic items of Company X are temperature sensitive and require storage in a temperature-controlled environment, these items can only be transferred when the temperature control facilities are up and ready in the new warehouse. This adds to timing complexity in terms of planning and the transfer process. Moreover, Company X need not maintain its own WMS. The 3PL has the cost advantage of amortizing the WMS maintenance costs over a larger pool of users. However, the drawback here is the one-time integration cost between the two systems and the risks involved during the relocation. Company X had already appointed a new 3PL by the time the authors commenced research and proposal development on this project. The 3PL uses a different WMS from Company X from which arose the need to develop, test, rework and retest the system integration to ensure a smooth roll-out.

Managing any one of the above constraints on its own is not difficult. However, when taken together they make the warehouse relocation exercise highly risky and prone to failure. This was the initial assessment of Company X's previous failed warehouse relocation project gleaned from available information presented about the company's action plan for those two previous exercises. It was clear that this project called for a low-risk approach to mitigate all possible risks that could arise from these five constraints on moving stocks, systems and data from one warehouse to another.

For the record, Company X had recently performed two similar warehouse relocation exercises in markets outside of Malaysia. Unfortunately, both exercises ended up in failure and Company X suffered huge financial losses. The past projects used the Big Bang Approach to transfer everything over one weekend and commence work on the new warehouse (system, operations, products) on the following Monday. Authors were told errors happened since the go-live Monday and accumulated to such severity that they had to halt the new warehouse operations completely. The scenarios tested and passed during the User Acceptance Test with the EDI connection could not stand the test of the volume and frequency of actual sales orders. Staff was suspected of not supporting the warehouse relocation project wholeheartedly as it affects their livelihood. Unfortunately, the damage had already been done and they suffered lost sales amounting to millions of dollars and thousands of dissatisfied customers due to the unfulfilled sales orders. The problematic new warehouse stored 100% of its inventory and therefore no other warehouse could come to the rescue and share the burden of the unfulfilled sales orders. Eventually, Company X had to roll back the warehouse transfer and operate using their initial process and system.

3. Methodology

To develop a seamless and efficient warehouse relocation plan, this study first examine Company X's end-to-end supply chain in Malaysia. Geographically, Malaysia is divided into two regions by the South China Sea, West Malaysia & East Malaysia (Figure 1). Company X has its sole warehouse in Petaling Jaya which is the main warehouse that receives all incoming supplies and delivers the orders to all of their 100+ retail shops in West Malaysia and its two regional warehouses in Sabah and Sarawak. The regional warehouses in East Malaysia subsequently deliver the orders to the East Malaysian shops. The warehouse also fulfils all internet orders nationwide and couriers the goods to the end customers (Figure 2).

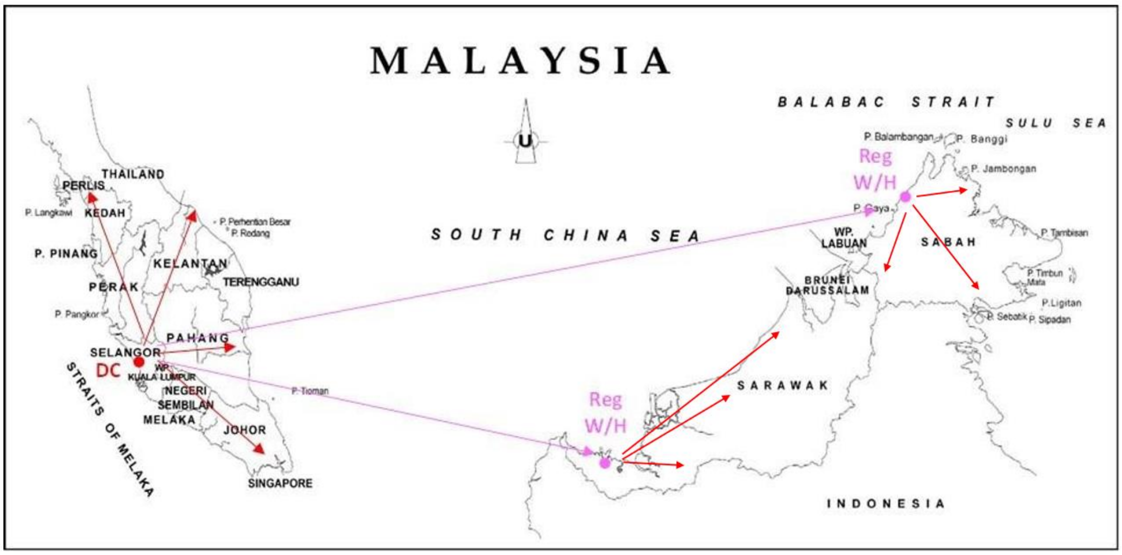

Figure 1 Company X regional warehouses

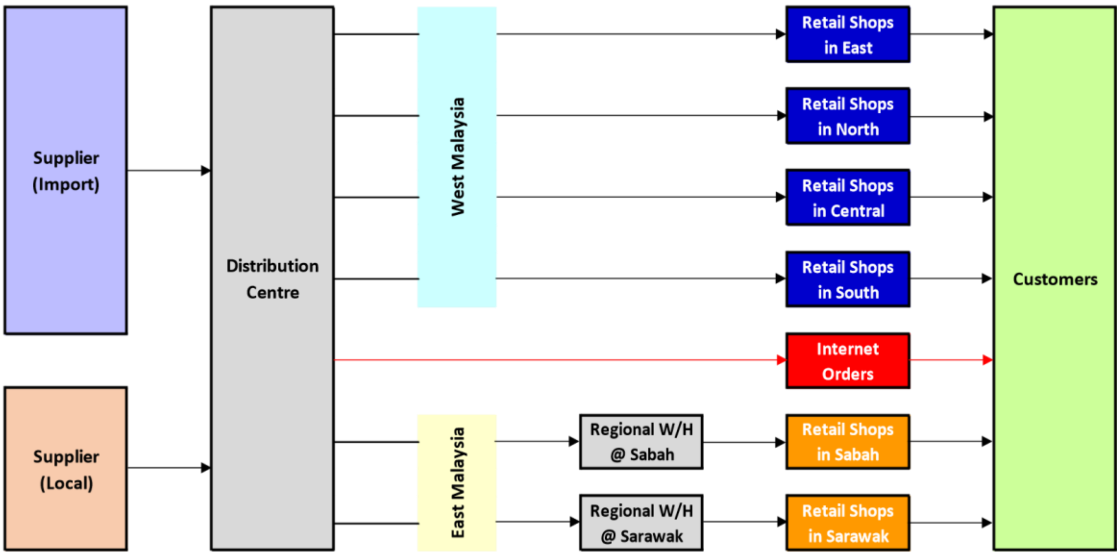

Figure 2 Company X's supply chain

Therefore, this study intends to propose a structured risk identification framework, as shown in Table 1 to capture all the key changes taking place in terms of area (i.e., Physical, Process, System, People and Vendor) and stages of the transfer (i.e., at origin warehouse, during the one-time transfer or at destination warehouse).

Table 1 Warehouse relocation risk identification and mitigation framework

Change Factors	**Risks Identified**			**Mitigation Plan**
	Origin Warehouse	**One-Time Transfer**	**Destination Warehouse**	
Physical				
Process				
System				
People				
Vendor				

4. Analysis of the existing warehouse operations

In order to develop a suitable solution for Company X, authors must first understand its existing operations. The current warehouse operations at company X covers several important areas as described in the next section.

4.1 Receiving

The receiving function is the starting point of inventory control in the warehouse. There are two types of incoming shipments. The first type of inbound shipment is the new or replenishment stocks ordered from either overseas or local suppliers. These stocks are shipped via container (sea freight from overseas suppliers) or truck (land from local suppliers). Company X receives on average 12 shipments per week, each shipment consists of roughly between 200 to 300 SKUs. The second type of incoming shipment is returned goods from end customers via Company X's agents and/or their retail outlets. An agent or retail outlet may return inventory due to multiple reasons such as damaged products, incorrect product delivered incorrect quantity or size, etc. After the returned goods were received, the warehouse performed a quality check on the items to determine whether the product was fit for resale, in particular for incorrectly sized items or incorrect items. If the product is deemed unfit for sale, it is then sent for disposal. On average, 98% of the inbound ships are the first type of inbound shipment and only 2% are the second type of inbound shipment.

4.2 Organizing and storing

All new and replenishment shipments are received in either a full pallet or in a secondary pack, depending on the minimum order quantity of each SKU. These shipments are then checked for correct quantity and condition before being stored in an assigned location on a pallet rack. These inventories then await two types of orders, sales orders or picking station replenishment orders. If there is a full carton sales order, it will be picked directly from the pallet racking area. If there is a picking station replenishment order, it will be picked and sent to the picking stations. At the picking stations, these cartons will then be broken into loose pieces to be put into the picking bins which are set up along the picking stations. A conveyor system runs through these picking stations, sending empty carton boxes with pick lists for operators to pick the correct item and quantity to be placed into the empty carton boxes. The carton boxes are then sent to the sealing station where they are sealed, and shipping labels are attached to every carton box. The sealed boxes are sent to the dispatch area to be sorted and then placed at the staging area according to the shipping lanes. Company X's inventory is categorized under

6 major product categories. These 6 categories consist of 8,102 different SKUs which take up around 6,889 pallet spaces. All inventories are assigned a status in the warehouse and Table 2 represents the breakdown of inventory by quantity and cubic volume based on the inventory status.

Table 2 Inventory breakdown by status

Inventory	Active(items meant for sale and may be processed to fulfil a sales order)	Inactive(sale items but no transaction for the past 6 months)	Discontinued(sale items but no longer available for sale)	Non-Saleable(items not meant for sale, such as point-of-sales material)	Phased Out(items meant to be disposed of)	Total
Quantity (pcs)	67,057,817	615,320	2,583,580	7,230,833	265,906	77,753,456
	86%	1%	3%	9%	0%	100%
Volume (m3)	8219	63	373	649	128	9,432
	87%	1%	4%	7%	1%	100%

4.3 Order picking and packing

Given that Company X's average sales order is about 30 line items with an average of 10 pieces per line item, predominantly in loose pieces, its picking area has set up a pick line with 1,200 bins on flow racks and a conveyor system to increase picking productivity. All sales orders received before the cut-off time are consolidated and released as a batch to the warehouse for their subsequent replenishment of the bins according to the batch of orders received before the next picking begins. There are two cut-off times for a day; (i) 8:30 a.m. for the morning batch run, and (ii) 12:30 p.m. for the afternoon batch run. When the warehouse receives the orders, it replenishes the pick line according to the orders they received for the batch. Insufficiency of pick line inventory triggers a full carton replenishment order to the warehouse storage section for the required SKUs in full cartons. The pick section then receives these full cartons, and breaks and replenishes the bins accordingly. Any unused loose pieces will remain in the carton and be sent back to the storage area in the picking section. Whenever an item is no longer needed in the pick bins, it will also be returned to the storage area of the pick section.

Once all the ordered items have been picked and placed into the shipping cartons, they are randomly checked for accuracy. Company X takes about 5% of the shipment for random checks. Subsequently, all shipping cartons are sealed and affixed with a shipping label displaying vital shipping information such as (i) Return address, (ii) Destination address, (iii) Recipient name, (iv) contact number, (v) Package weight, (vi) Shipping lane, (vii) Electronic tracking number and barcode.

4.4 Delivery

Company X processes and fulfils 2 types of sales orders and multiple modes of deliveries as shown in Table 3.

Table 3 Order type and delivery mode

Order Type	Location	Recipient	Transportation Mode
Orders to replenish retail outlets	West Malaysia	Retail Outlets	Land - Truck
	East Malaysia	Regional Warehouse	Sea - Container
Orders to individual customers	West Malaysia	End User	Land - Courier Service
	West Malaysia	Staff	Land - Courier Service
	East Malaysia	End User	Land - Courier Service

Company X has more than a hundred retail outlets in West Malaysia. These outlets are grouped into 30 delivery lanes given their proximity within the same lane but different travelling distances and times for different lanes. Each outlet is filled with land transportation trucks, departing from Company X's warehouse around 7 p.m. 3 times a week. Company X also has about 20 retail outlets in East Malaysia which gets their replenishment from their 2 local regional warehouses in East Malaysia, 1 in Kuching and 1 in Kota Kinabalu. Company X's warehouse only replenishes East Malaysia regional warehouses weekly via sea freight and not directly to the retail outlet. Company X also sends orders directly to its end users who place orders online. Their online orders are processed on the same day if received before the processing cut-off time or else processed the following day. To get the orders promptly to the end users, Company X uses the services of a courier company that collects the packages between 5:00 p.m. to 7:00 p.m. daily. Staff orders are also similarly shipped through a courier company following the same process as end users. Company X warehouse also includes online orders from Singapore for the reason of economies of scale. It is the same process as the Malaysian online orders, except Singapore orders have one additional process, custom clearance in Singapore. As such, these orders are handled by a different courier company possessing the expertise to clear Singapore customs.

4.5 Delivery lead time

Given the travelling distance, all the collected land orders are delivered the next working day, including orders to Singapore. However, sea order delivery to East Malaysia is based on the vessel schedule. A container is brought into the warehouse for stuffing and then sent out to the port a few days before the vessel's departure time.

4.6 IT system

Company X's IT setup is relatively simple, OMS to handle orders from multi-channels, ERP to process the incoming sales orders and handle other enterprise transactions (e.g., Purchase Orders) and WMS to control the operations within the warehouse. Figure 3 demonstrates the high-level illustration of Company X's current IT setup.

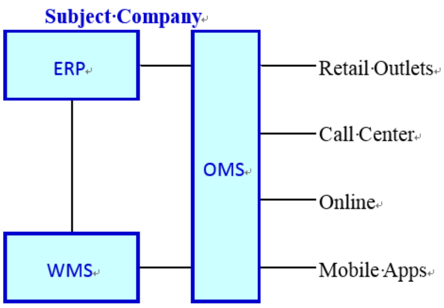

Figure 3 Existing IT setup

Moving forward, when a 3PL uses a different WMS from Company X, the IT architecture landscape needs to change. Whenever there is change, there is risk. The to-be IT architecture will have to link with the 3PL's WMS for the timely transmission of information. Further Company X still has its regional warehouses in East Malaysia to maintain. Thus, a new warehouse location "3PL mirror" has to be created in Company X's existing WMS and Application Programming Interface (API) needs to be created to link 3PL's WMS back into Company X ERP and WMS as shown in Figure 4.

5. Findings and discussion

5.1 Risk assessment of relocation exercise

To systematically identify all the risks in this study, authors look for changes that will occur in all three stages of the transfer as shown in Figure 5. Stage 1 at Origin Warehouse (Company X's warehouse), Stage 2 during the one-time stock transfer process (from Company X to 3PL) and Stage 3 at Destination Warehouse (3PL's new warehouse).

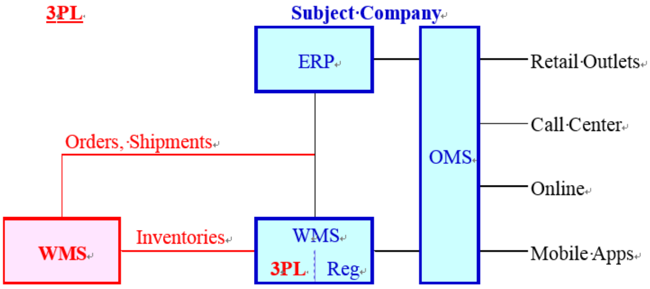

Figure 4 New IT setup

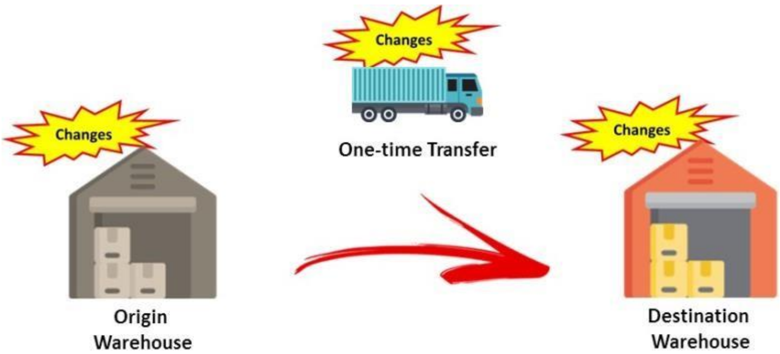

Figure 5 The 3 stages of transfer

Subsequently, at each stage, all the activities are scanned through for any departure or variance from current practices to identify what exactly will be changed and their potential risks. Then, for every change identified, authors developed the potential risk associated as well as the probability of occurrence as shown in Table 4.

Table 4 Warehouse relocation changes and risk identification template

Change Factors	**Transfer Stage**			**Risk**	**Profitability**
	Origin Warehouse	**One-TimeTransfer Process**	**Destination Warehouse**		
Physical					
Process					
System					
People					
Vendor					

The authors would then record all the change factors identified and the risks involved and summarized in Table 5.

Table 5 Changes and risk identification

Factors	Risk	Mitigation
Capacity	Is the storage capacity sufficient for the next 2 years of Company X’s business?	New warehouse capacity is designed to meet in the new warehouse
Storage Condition	Does the new warehouse have the appropriate temperature storage condition for Company X	No new products with different temperature storing conditions. The new warehouse is designed to cater to existing temperature requirements.
Equipment	Does the new warehouse have the right type and sufficient Material Handling Equipment (MHE) fleet for Company X’s operations?	The same storage and operating process is in the destination warehouse as the origin warehouse. Thus, the same MHE is adopted but quantity is based on the next 2 years demand.
Utilities	Is the electrical/water/broadband/Wi-Fi supply in the new warehouse reliable?	The new warehouse already has a standby power generator built and a temporary water supply from a tanker has been arranged. Extra Wi-Fi dongles are bought and available should broadband fail one day.
Operation readiness	Are the new warehouse operation procedures suitable for Company X's requirements, in terms of volume, speed and accuracy?	Jointly develop the new SOP together with Company X and 3PL so that Company X’s insight can be transferred to 3PL.
Transfer	Company X had never moved a warehouse before. Massive losses in inventories could occur during the transition if they are unaccounted for by both parties. The transfer workload is over and above the existing staff’s workload. Not all transfer tasks could be completed in time.	Commence the transfer early, prepare to work overtime or during the weekend if the transfer is behind schedule and increase resources to speed up the transfer.
IT System	System integration does not work properly when going live. System integration fails persistently after goes live.	Set up a cross-function hypercare team to be on standby from go-live onwards to fix any occurring issues immediately. Implement Plan B. Roll the new operations back to the origin warehouse where the existing process and system are proven.
People	Company X’s staff would be notified of the redundancy notice before the warehouse transfer and they may sabotage Company X’s transfer operations by stealing the stocks or purposely mixing the wrong items in the shipping carton, working slowly or having poor attendance.	Compensate the staff following local labour law for their years of service with the company. Maintain constant dialogue with affected staff and arrange job opportunities for them in 3PL. Have another backup plan for labour resources from 3PL to come to Company X and operate the warehouse.

Finally, the authors developed a mitigation plan for every change and risk identified from the exercise above. To ensure success, Plan B is developed on top of the initial mitigation plan, so that authors would know exactly what to do if authors encounter failure on launch day as depicted in Table 6.

5.2 Relocation approach and assessment

To migrate the warehousing operations to the 3PL without any disruption to current operations and service levels, three relocation approaches were evaluated. Based on Company X’s failure of two previous relocation projects causing extensive losses, a major process management change in the way the relocation exercise was implemented and executed was critical in ensuring that history did not repeat itself. In order to do so, an approach based on a business reengineering process was used and 3 approaches were evaluated to determine the new approach to adopt. The 3 approaches were deliberated next.

Table 6 Risk mitigation action plan

Change Factors		**Transfer Stage**			**Risk**	**Profitability**	**Mitigation Plan**	**Mitigation Plan Strategies**
		Origin Warehouse	**One-Time Transfer Process**	**Destination Warehouse**				
1.Physical	Warehouse Capacity			Different building	Wrong setup & insufficient Capacity	Low	Design for the next 2 years demand	Source for overflow warehouse
	Storage Temperature			Different building	Wrong setup & insufficient Capacity	Low	Design for next 2 years demand & New Product Development	Source for overflow warehouse
	Equipment			Different setup	Wrong setup & insufficient Capacity	Low	Follow the same type. Back up from 3PL other clients	Lease more
	Utilities			Different building	Failures	Low	Power generator. Chartered water tanker. Extra wi-fi dongles	Get 3rd site on standby.
2. Process	Warehouse Operations			New 3PL's Processes	Missed functionalities &Productivity	Mid	Develop 3PL's SOPs together for knowledge transfer	Continuous improvement
	On-Time Stock Transfer		Workload, speed & accuracy		Missing, wrong, dispute &delay on transfer	High	Joint count with 3PL at each level & start traceably	Work overtime & weekends
3. System	PL's WMS			Different WMS	Missed functionalities.	Mid	Rigorous tests - Unit Test, User Acceptance Test, Endurance Test & Stress Test. Hypercare team on standby.	Go live early but on a small scale. progressively
	Integration with 3PL			Different WMS	Failed integration	High		
4. People	Subject Company's Staff	Made redundant			Attendance, productivity & Sabotage	Mid	Lawful compensation, open dialogue & exit assistance.	3PL crew to take the origin warehouse operations
	PL's Staff			New crew	Mistakes & productivity	Mid	100% scan on pick.	Start early to go up the learning curve
5. Vendor	Suppliers			New location & Processes	Mistake & delay	Low	Assistance at the new site for familiarization	
	Transporters			New location & processes	Mistake & delay	Low	Same transporters. Assistance at a new site for familiarization	3PL's transporters as standby

5.2.1 Big Bang Approach - 100% inventories, all over a weekend

In this approach, 100% of the inventory in the existing warehouse is moved to the new 3PL warehouse over the weekend. The 3PL then receives these inventories into their own WMS and immediately begins operating 100% of the functionalities from Monday onwards. Company X's existing warehouse then ceases operations from the same Monday onwards as all stocks are already in 3PL's new warehouse. Any orders after that transfer cutoff deadline are fulfilled out of the new 3PL warehouse. Using this approach, only one warehouse is fully operational at any moment in time. Figure 6 illustrates the Big Bang Approach.

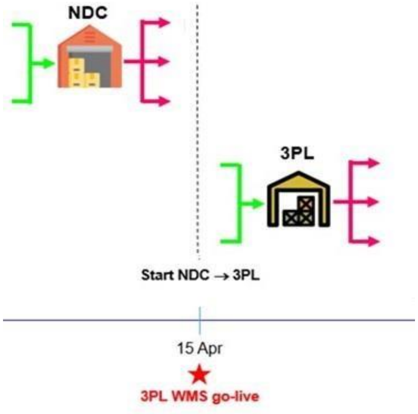

Figure 6 Big Bang Approach

The advantages of this approach are a cleaner relocation process with a clear cut-off timeline for the transfer. It is easier for staff, operators and customers to comprehend and remember the day of the relocation to be known as 'D-Day'. Additionally, no need to maintain multiple systems, processes, or teams of people as opposed to the parallel run approaches and lower operating costs for the 3PL as 100% of their resources could be planned and commenced to work from that one day. Nevertheless, the disadvantages of this approach are considered high risk as the `placing all eggs in one basket' approach. If there are any unforeseen errors, then operations for 100% of the inventories are at risk. Additionally, this approach needs a huge fleet of trucks and manpower to load 6,889 pallets onto trucks, drive 6,889 pallets over to the 3PL warehouse (or 345 trips), unload 6,889 pallets, count and receive 6,889 pallets into 3PL WMS, put away 6,889 pallets into the correct storage location, fill up 1,200 picking bins with the correct items, etc., all over a short time span of a weekend.

In the Big Bang Approach, only one key advantage was identified. It involved the reduction of the risk of an out-of-stock situation created when the inventories of all SKUs are required to be split into two different warehouses resulting in reduced stock coverage at each warehouse. By fulfilling orders from only one warehouse at a time, inventory can be pooled to increase the stock coverage of a certain SKU. The disadvantage of this is that the success of the warehouse relocation exercise is solely dependent on the 3PL service provider's speed and efficiency in transferring and receiving both the physical stock and data into their WMS system. Any delay results in orders not being fulfilled within the expected service level lead time which results in poor customer satisfaction and loss of sales. Further, this approach does not offer any risk mitigation alternatives to ensure that there is no supply disruption. Service levels are crucial for an MLM company in ensuring that the relationships between customers and distributors are not jeopardized. Thus, the authors do not recommend this approach due to its high-risk element as well as the high concentration of resources required over a weekend which is unfeasible for Company X.

5.2.2 Gradual Transfer Approach - 100% of product category, category by category

The second approach involves a gradual transfer of inventory, product category by product category from Company X warehouse to 3PL. For example, in Week 1, Company X would transfer all skincare products over to the 3PL new warehouse and subsequently transfer 100% of another product category in Week 2. Using this approach, 100% of stocks of the selected product categories are moved to the 3PL warehouse. The decision on which warehouse fulfils an order is based on where the inventory of SKUs in a certain product category is located. For example, skincare care orders are fulfilled from the 3PL warehouse in Week 1 while other product category orders are fulfilled from Company X's warehouse. Figure 7 illustrates the Gradual Transfer Approach by product category. This means that when a sales order consisting of multiple product categories is received some of the line items are fulfilled from the 3PL new warehouse while the rest are fulfilled from Company X's warehouse. Using this example, the customer service staff is then required to route the skincare order line items to 3PL while other order line items to the company. Company X's existing warehouses are based on where the inventory is located at that point in time. The same SKUs will not be located at both warehouses concurrently and only one warehouse is able to fulfil an SKU at any moment in time.

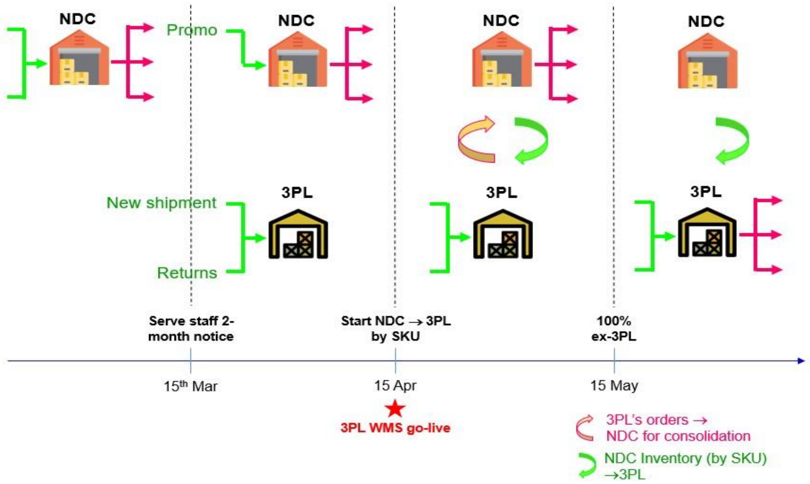

Figure 7 Gradual Transfer Approach by product category

The advantages of this approach are eases off the huge fleet and resources required for the Big Bang Approach. The transfer can be stretched over several weeks whereby the fleet size and resources would not result in a bottleneck. This approach also offers lower risk. At any one transfer, only one product category is involved and therefore should any issue occur only that category of products are at risk. However, the disadvantages of this approach are costlier where two operations teams and systems need to be up and running during the overlap period. This approach also creates additional complexity and attendant problems given that there are two fulfilment points for sales orders involving multiple product categories. This can be resolved by consolidating the products from two warehouses into one carton box before delivery to end customers. However, this causes additional processes and increased costs. Additionally, there are higher chances for delay and errors during the consolidation of products from two warehouses. Thus, do not consolidate the products but send two separate shipments from two different warehouses for one sales order. This creates confusion among the end users as they would be uncertain whether the first carton received is incomplete because of two fulfilment sources or a wrong pick by the warehouse.

Although the relocation risk has been reduced by this approach, the authors do not recommend this given its additional and higher complexity in accurately merging two separate orders with any system or tool support which is very risky. Furthermore, creating confusion among end users is also not an acceptable approach. However, relocation of order fulfilment and inventory by-products has several advantages. The first advantage allows for the early transfer of goods to the 3PL warehouse to move up the learning curve earlier. This allows the 3PL warehouse staff more time to familiarize themselves with the different products and new processes of receiving, staging, put-away, storage, issuance, picking, packaging and shipment. Secondly, since order fulfilment for certain products is carried out by only one warehouse at a time, there is no need to split the inventory and hold it at two different locations. This results in a higher stock coverage for each product thus reducing the probability of the occurrence of a stock situation. This approach, however, creates additional complexity in the order fulfilment process as now one order could involve products that are located in two different warehouses (existing warehouse and 3PL warehouse). Additional work is also created as either the 3PL warehouse needs to pick and fulfil the order partially and then shunt it to the existing warehouse for further consolidation before shipping, or vice versa. Apart from the additional cost incurred from shunting, where the orders are not consolidated and shipped separately from different warehouses may cause an increase in transport costs which would offset any savings from the warehouse relocation exercise. Apart from introducing additional handling of goods, this approach is also expected to increase the order fulfilment lead time due to the additional steps in the fulfilment process that may result in damaged or misplaced goods.

5.2.3 Gradual Transfer Approach - 100% of a region volume, region by region

The third approach is to transfer 100% of a region's forecasted volume to a 3PL new warehouse, one region at a time. Instead of moving 100% of a product category (at a fraction of all SKUs), authors transfer 100% of all SKUs at a fraction of the national volume (based on regional sales forecast volume) to the 3PL new warehouse. Using this approach, authors attain the benefits of both worlds, minimization of risks arising from the gradual transfer (only a fraction of all inventories is at risk at any single moment in time), as well as the elimination of additional complexity from consolidating fulfillments from two different warehouses into one delivery. In this approach, a portion of the inventory of all active SKUs is transferred to the 3PL warehouse. This results in both the existing warehouse and the 3PL warehouse carrying the same type of SKUs at the same time. This will allow any orders to be fulfilled by either one of these warehouses. However, the decision on which orders will be fulfilled by which warehouse is made is based on the region the customer is located in. When customer service staff receives an order, they are to route it to the correct warehouse based on the ship-to address. Figure 8 illustrates the gradual transfer by the delivery region.

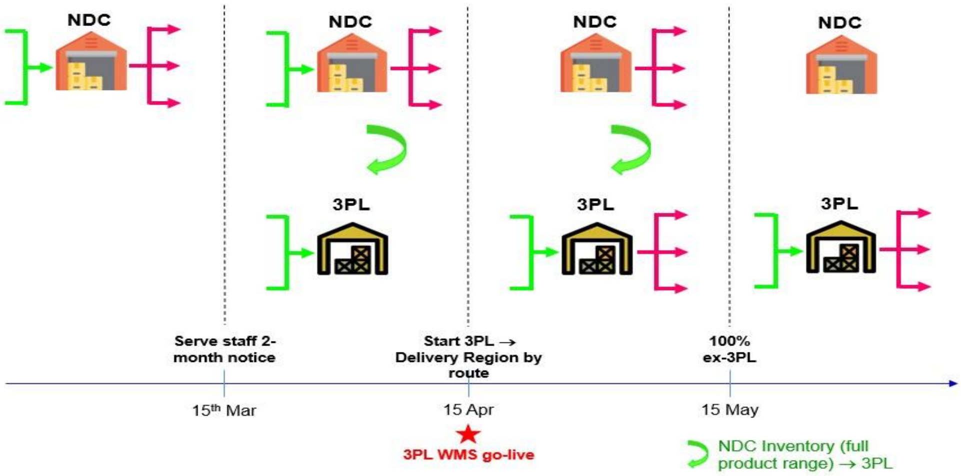

Figure 8 Gradual Transfer Approach by delivery region

The advantages of this approach are minimal risk given it is a gradual transfer as well as avoiding the need to consolidate orders from two warehouses because all SKUs are available at both warehouses at any moment in time. There is also a partial inventory move of all active SKUs. Similar to the second approach, the third approach of fulfilment by region/customer offers the same advantage of speeding up the learning curve. Any risk associated with the possibility of sabotage from the existing warehouse staff who may be disgruntled after being served with redundancy notices will also be reduced as a turnkey backup plan is available should any issues arise. Additionally, for whatever reason should the existing warehouse suddenly experience a major disruption to its operations, the 3PL warehouse is able to function to fulfil the orders. Lastly, there is no shunting of partial orders and matching is required as only one order can be fulfilled by either warehouse. This will also eliminate the requirement for additional order fulfilment lead time and increase transportation costs. However, the risk of an out-of-stock brought on from reduced stock coverage is increased in this approach, especially for SKUs that are low in physical quantity as it becomes even harder to meet the demand. For example, the nationwide demand for SKU A is 10 pieces and the existing warehouse has 15 pieces on hand. If during the relocation process period, only 5 pieces are transferred to the 3PL warehouse, but an order was received for 7 pieces, this would result in an out-of-stock which would negatively impact service levels to the customer.

5.2.4 Approach to implement

A decision on which approach to adopt during the implementation of the warehouse relocation exercise was based on considering a few factors including a thorough assessment of the advantages and disadvantages of each approach. Additionally, the risk appetite of Company X taking into consideration all the risks identified during possible risk mitigation strategies, and the business requirements of Company X in terms of service levels and disruption to its existing operations. After careful consideration and deliberation with the management of Company X, it was decided that a 'Gradual Transfer – 100% of a region volume, region by region' was to be adopted as it offered the lowest risk impact out of all the 3 proposed approaches. The transfer approach was then implemented, and the success of the transfer strategy was measured based on the results of a series of Key Performance Indicators (KPIs).

5.3 Results and KPIs

The purpose of a warehouse relocation project is to transfer the functionalities from the origin warehouse to the destination warehouse. Therefore, the yardstick on whether a warehouse relocation project is successful or otherwise depends on the success of the new operations in the destination warehouse. Since the key functionalities of a warehouse are goods receiving, storage and delivering the goods to end customers, the authors set 1 system integration and 3 operation KPIs to ascertain the success of our warehouse relocation strategy which will be deliberated in the following section.

5.3.1 System integration with the 3PL company - order transmission

The creation of customer sales orders, both before and after the warehouse relocation sent to Company X remains unaffected. However, changes do occur after the orders are received in Company X's order management system (OMS). In the new arrangement, the sales orders must now be sent to the 3PL warehouse, instead of the Company X warehouse. Given that the 3PL uses a different WMS, the authors used an API, a software intermediary that allows two applications to talk to one another. Sales orders are now being electronically transmitted from Company X's OMS to 3PL's WMS with immediate effect via this API. However, API is new to Company X and therefore it carries the potential risks listed including (i) design flaws, wrong architecture (data points are connected wrongly) and incomplete architecture (some data points are not connected); (ii) speed (orders take too long to reach 3PL WMS); (iii) capacity (cannot handle large enough volume), and (iv) timeliness (the transmission interval is too long).

Although authors had taken pains during the Unit Test, User Acceptance Test and Stress Test to ensure the API was properly developed, nothing compares to actual live performance. The sales orders need to be approved by Company X first before they can be transmitted over to 3PL for processing. This is the same process as before and the manual order approval process is maintained. To assess the order transmission performance, the authors measured the time of the batch of orders placed in the morning and noon that reached 3PL WMS. Should there be any flaw in the API development this would be captured and would appear negatively in this KPI. Before the relocation, Company X had two batches of orders released to the warehouse for processing every day, one in the morning and one around noon. Orders were being released in batches and not real-time for higher productivity reasons, as the warehouse needed to replenish the pick lines according to the items ordered before the batch run could begin. This warehouse relocation has now added a new API process to link the Company X system to 3PL.

The authors also tracked the timeliness of the orders being received by 3PL at 8:00 a.m. and 12:00 noon from Day 1 of the go-live onwards. The authors observed a total of 5 delays over the one-month period, three of which were due to system bugs while the other two were due to intentional human intervention. All three system failures occurred on the first day of a new phase, e.g. Go-live (East), addition of North and addition of Central. This is because all changes present inherent risks. The progressive transfer strategy is to divide the risks into smaller manageable sizes over a longer period so that the team can divide and conquer one by one. Even if the issue occurs, the impact is only on a fraction of the total business volume that would be impacted, i.e.: 20%, 45%, 70%, 99% and 100% in this case. Figure 9 shows the timing of orders received by the 3PL WMS while Figure 10 shows the impact of timing of orders received on business volume. Next is to assess the success of the original warehouse operations that have been transferred to the destination warehouse. The authors set up three KPIs to measure its picking, packing and delivering activities respectively.

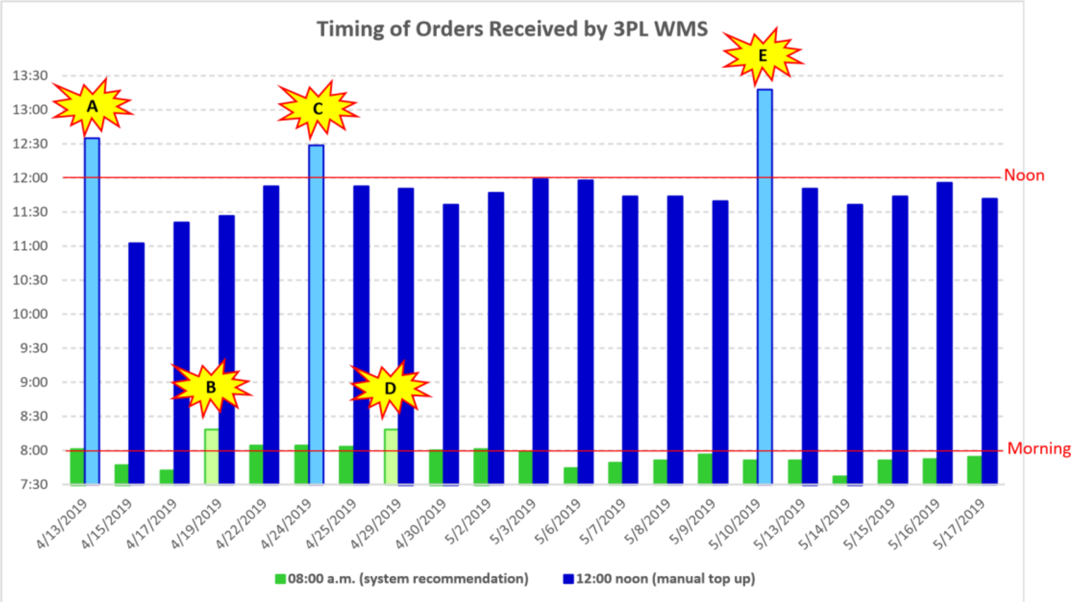

Figure 9 Timing of orders received by 3PL WMS

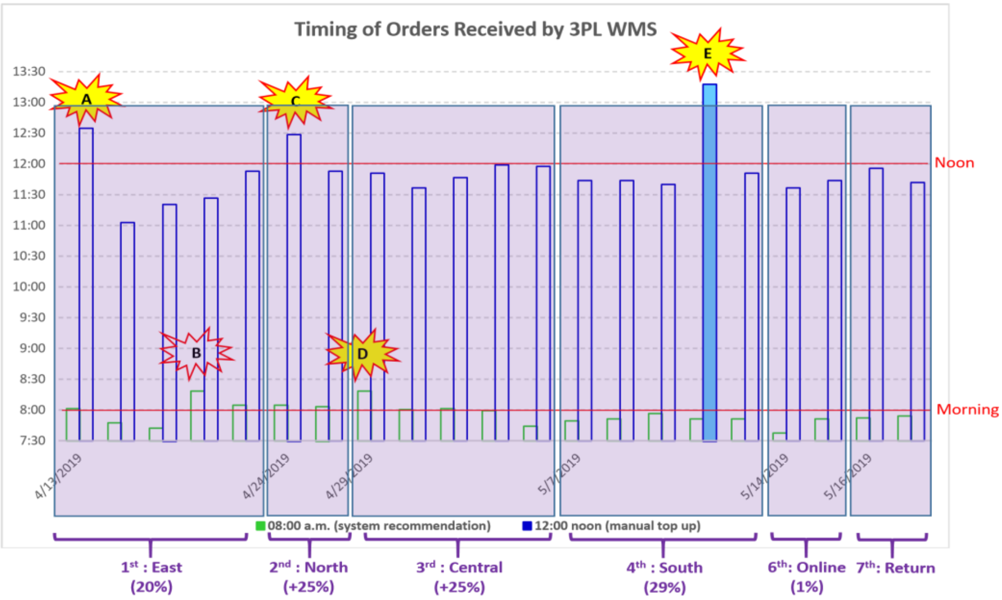

Figure 10 Impact of timing of orders received on business volume

5.3.2 Operations – picking productivity

Once the orders are successfully transmitted over to the 3PL warehouse, the operations team begins to print out the sales orders to be inserted the orders into the shipping cartons accordingly. Then pickers pick the corresponding items in the sales order from the pick lines to be placed into correct shipping cartons. Subsequently, there is a checker to check the accuracy of the pick by using a barcode scanner to scan every item in the shipping carton against the order in the computer. If all the items are correct, it then proceeds to a sealing process or else it is rejected and returned to the picker for repick.

To determine whether the picking functionality is properly transferred to the 3PL, the authors measured the picking productivity and accuracy. For picking productivity, the authors chose the maximum productivity in an hour of the day to be the yardstick because average picking productivity fluctuates according to the order quantity which varies daily. If the process know-how, resources and tools are not properly transferred over, 3PL's productivity (max) and accuracy will be poor. During the first couple of days of go-live, the picking productivities were disastrous. On the first day, operations were intermittent. Workflow was frequently stopped due to data format issues between the new brand of scanners with 3PL's WMS and familiarization of the new operators on the operation procedures despite training. Zero orders were completed on Day 1. On the second day, although the scanner issue was resolved, the new crew of operators were still learning Company X's products and processes. Despite being slow, the crew managed to pick 104 pcs of items per man hour maximum on Day 2. And from Day 3 onwards, picking productivity continued to escalate. Figure 11 shows the morning and afternoon increase in picking productivity over time.

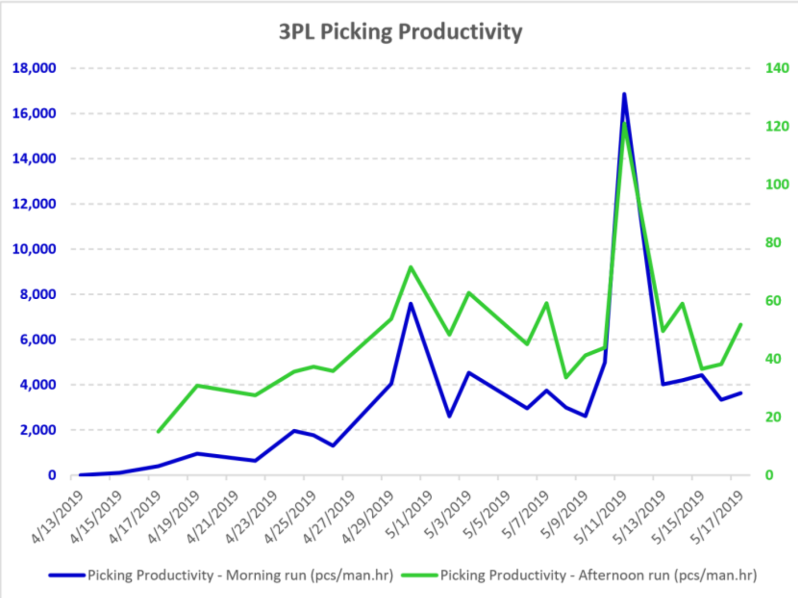

Figure 11 3PL picking productivity

Whenever a new region is added to 3PL operations, the picking productivity jumps up to a new level. This can be seen in Figure 12.

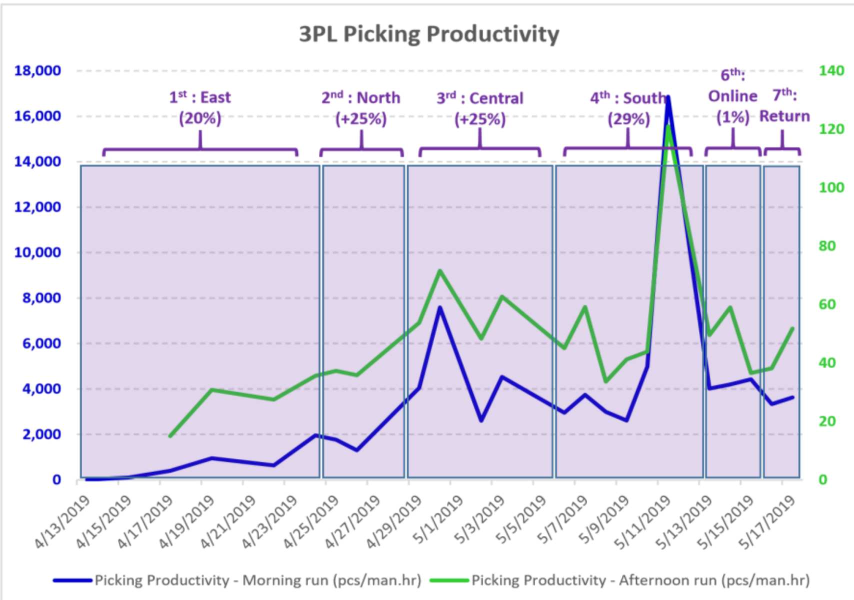

Figure 12 Impact of 3PL picking productivity on business volume

If the transfer strategy was based on the Big Bang Approach, i.e., 100% of the volume is transferred to 3PL Warehouse from Day 1 onwards, there would not have been any orders being fulfilled due to the scanner issues and operator's familiarization for 2 days. If two days of orders had accumulated, this would snowball into Day 3 and the pressure to complete 3 days of orders (3×100%) on a single day would be huge, as resources were never planned to cater for 3x volume. As such, this had a negative spiral effect that would spill over into Day 4, Day 5 etc. Customer complaints would have poured in and diverted the project team's resources to attend to the complaints, ultimately jeopardizing the entire transfer project.

5.3.3 Operations – packing completeness

After picking, the cartons are sent for packing. At this packing station, all items in the carton are scanned and checked against the sales order in the system. If there is any wrong item or quantity detected, the whole carton is rejected and returned to the picking stations for re-pick. Only 100% accurate cartons may proceed and sent for sealing and subsequently sent to the shipping staging area to be stacked by delivery route for collection by the transporter. The picking accuracy on the first two days of go-live was disastrous as the 3PL new scanner's data format setting was not in sync with its WMS (Figure 13). Given the mismatched format, the system showed 0% accuracy because the scanner was sending one digit less (without the check digit) against the WMS record. Fortunately, this issue was solved later in Day 2. On Day 3, picking accuracy reached 99.7% but could not stabilize as volume increased from Day 4 onwards. It was only on Day 7 onwards that their picking accuracy stabilized above the target of 99.7%. Once again, had Company X adopted the Big Bang Approach, its picking accuracy would surely have been worse than the current result and its service levels would surely have been negatively impacted.

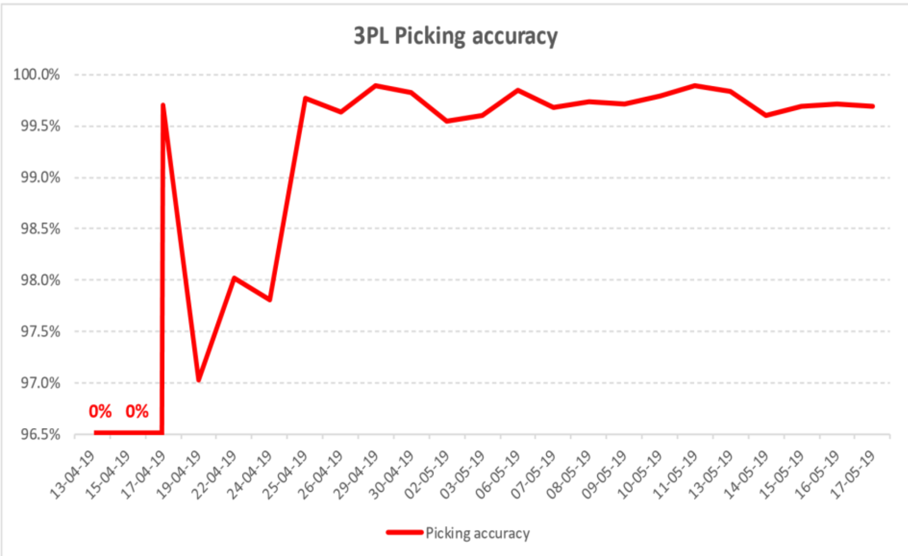

Figure 13 3PL picking accuracy

5.3.4 Operations – On-Time-In-Full (OTIF) delivery

The ultimate test of the success of warehouse relocation is the service level of the destination warehouse. It is useless if the destination warehouse can perform its operations perfectly, but the orders cannot successfully be delivered to the end customers. Fortunately, Company X chose to use the same transporter. Thus, the changes are only limited to the new pick-up location and the handover procedure with the 3PL, instead of the Company X warehouse of origin. The transporter achieved 100% delivery OTIF level performance every day from the new destination warehouse, despite occasionally the 3PL warehouse could not get the orders ready to be loaded to the transporter by the agreed pick-up time. Figure 14 illustrates the delivery of OTIF results which speaks for itself.

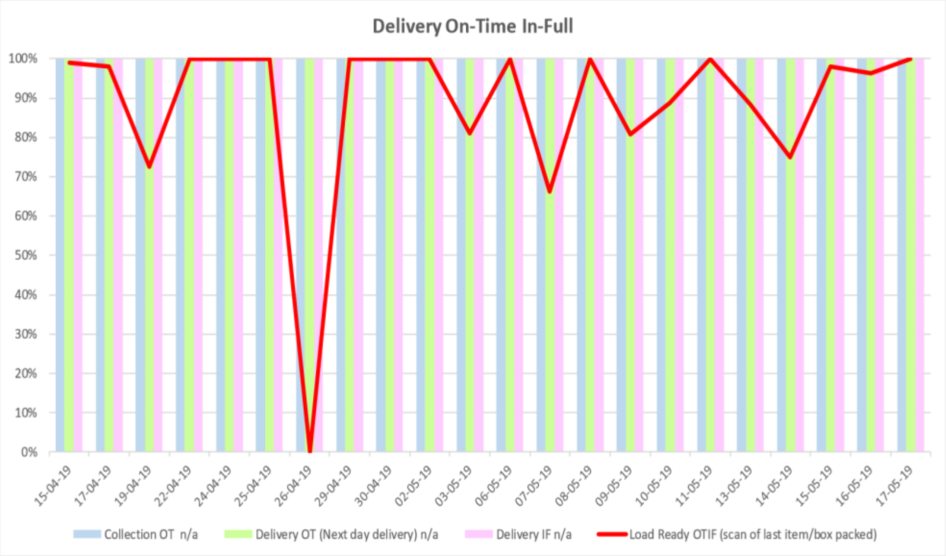

Figure 14 Delivery OTIF

This is instructive as it demonstrates that if there are fewer changes this translates into lower risks. If Company X had also changed the transporter in this warehouse relocation exercise, it is reasonable to expect worse delivery OTIF level results as compared to maintaining the same transporter.

6. Recommendations

In summary, the challenges faced during the Go-Live period included delays in the transmission of sales orders to the third-party logistics provider (3PL), zero picking on Day 1, low picking productivity in Phase 1 (with a gradual increase over time), sub-standard picking accuracy in the first 7 days, and delays in handing over packed orders to the transporter during high-volume days. The authors envision the possibility of these same issues arising during the three warehouse relocation approaches previously identified: (i) the Big Bang Approach, (ii) Gradual Transfer by Product Category, and (iii) Gradual Transfer by Region Volume.

It is evident that if all five issues were to occur simultaneously on Day 1 of the Go-Live while using the Big Bang Approach, it could prove disastrous for Company X. This could result in: (i) zero sales for Company X on Day 1 as 100% of their sales orders could not be shipped from the new warehouse; (ii) a potentially low On-Time service level on 100% of sales orders in Phase 1 due to low picking productivity, leading to unprocessed orders spilling over into the next day; and (iii) a potentially low In-Full service level on 100% of sales orders within the first 7 days due to sub-standard picking accuracy, potentially resulting in stock losses.

Hence, the two Gradual Transfer Approaches are superior in this case compared to the Big Bang Approach. The Gradual Transfer Approach enables the spreading of these issues to a smaller volume of orders affected during the warehouse relocation, reducing potential losses, such as a 20% loss of total sales orders during Phase 1. Finally, it is suggested that the Gradual Transfer Approach by region volume is the superior choice. This approach increases the complexity of the processes for sales orders that need to be fulfilled from two warehouses, potentially negatively impacting efficiency.

7. Managerial Implication

Company X's decision to relocate its warehouse and outsource warehousing activities was part of a broader strategy aimed at optimizing its assets and streamlining its workforce to enhance overall performance. This move allowed Company X to become more efficient, agile, and focused on its core competency, which is marketing and selling products through its MLM network. However, the implementation of warehouse relocation projects in such circumstances carries substantial risks that can negatively impact responsiveness and service levels (Nagahan and Akın, 2018). Previous warehouse relocation projects at Company X resulted in significant financial losses, highlighting the inherent complexity and risks associated with such endeavors.

To address these risks and ensure a successful relocation, a resilient warehouse relocation strategy is crucial. The potential for lost sales and disruptions to service levels necessitates careful planning (Petersen and Aase, 2016).

The project addressed challenges, including a tight timeline for completion, the need for redundancy notices to warehouse operators, and the requirement to maintain order fulfillment service levels. A thorough analysis of Company X's existing operations was conducted to identify potential risks. Change factors at each stage of the relocation were evaluated, and a comprehensive risk identification process was undertaken. Each identified risk was assessed in terms of probability, and corresponding risk mitigation action plans were developed.

Several relocation approaches were considered, and a gradual transfer of operations by region was chosen due to its lower operational risks. The success of the warehouse relocation project hinged on the performance of operations at the new warehouse (Petersen and Aase, 2016). KPIs were used to assess warehousing operations post-relocation. Initial challenges were observed in the early days of the relocation, affecting picking productivity, packing completeness, and OTIF (On-Time In-Full) delivery measures. However, these issues were swiftly addressed, and operations improved from the third day onward.

8. Limitation and future research

The experiences during the initial teething period underscore the importance of resilience in warehouse relocation strategies. Despite careful analysis, risk mitigation planning, and method selection, unforeseen issues can arise, impacting the relocation process. This highlights the critical need for a resilient approach when embarking on high-risk and complex projects like warehouse relocation to minimize their impact on overall company operations. While Company X provided compensation packages and absorbed some workers into new 3PL operations, a comprehensive change management plan for redundant workers was lacking due to budget constraints. Future research in warehouse relocation projects should consider developing a robust change management plan to address the risks associated with redundant workers and further enhance the resilience of warehouse relocations.

Conflict of interest

The authors declare no conflict of interest.

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