Decision making in the warehouse expansion strategy at PT Dwitama Global Persada

Fransisca Dini Ariyanti, Raquel, Dylan Velio

Industrial Engineering, Faculty of Engineering, Bina Nusantara University, Jakarta, Indonesia 11480

Email: dini.ariyanti@binus.ac.id, raquel@binus.ac.id, dylan.velio@binus.ac.id

Abstract. The increasing trend of online shopping has made the third party logistic company (PT Dwitama Global Persada) need to expand its capacity. This study aims to determine how much warehouse capacity should be increased based on demand forecasting, what alternatives can be applied to warehouse expansion, and how to make the decisions. There are two different options, namely renting a new warehouse or adding multi-tier mezzanine to the current warehouse floor. Decision making is achieved after calculating the demand forecast using the Holt method until April 2022, showing need to increase space capacity by 20%. Determination of annual costs based on service life and operational costs, followed by AWA annual worth analysis to compare the two options. The result showing that the multi-tiers floor option is more economical 12.6% compared to renting a new warehouse.

Keywords: Expansion, Warehouse Space Planning, Annual Worth Analysis, 3rd-party-logistic

1. Introduction
In achieving supply chain efficiency, warehouses play an important role in adding value to achieve competitive advantage and support business growth.[1] This research discusses the challenges faced in the fast growing online business and requires a 3PL (3rd-party-logistic) industry or rental warehouse provider. Recently Online sellers tend to choose to open stores online (3PL warehouse) rather than offline because there is no need to spend large amounts of capital. [1], [2] Integrated logistics activities such as transportation, warehousing, consolidation and distribution of cargo, negotiation level and logistics information systems are a series of businesses provided by 3PL industry. Thus, after ordering goods, many online sellers prefer to store their products in 3PL distribution centers thereby reducing processing time for shipments after the online buyer ordered.

The case study conducted on Indonesia 3PL warehouse and distribution center, PT Dwitama Global Persada or DGP, during March to July 2020. DGP warehouse stores online seller products and become a distribution center to deliver goods directly to online buyers. Increasing demand from online buyer which prefer ready stock products, make online sellers who previously used private residences need a place to store stock of goods. The cost of renting a dedicated warehouse is very large and sometimes the area of warehouse hired cannot be utilized to the maximum because the amount of stock stored is not in large quantity, hence it can reduce the profit of the online sellers. Thus, the utilization of rental warehouse or 3PL warehouse can be the way out. In terms of cost is more affordable when compared to a dedicated warehouse. The research aims are to determine how much warehouse capacity should
be increased based on demand forecasting, what alternatives can be applied to warehouse expansion, and how to make the decisions.

2. Literature Review

2.1. Warehouse Process

A warehouse is an additional area used to store goods, spare stock, and more. When goods are received in the warehouse usually the goods are in large quantities or bundling later in the warehouse the goods are processed into fewer unit sizes [3]. Logistics activities are a process that adds value to an item through management in procurement, movement, storage of goods, and packaging [4]. Logistics activities include input, process and output processes. The input process starts when the goods enter the warehouse or are known as inbound. After the inbound process, the next activity is to include the warehouse process. Warehouse expense contributes as much as 15% of the total cost in the overall logistics activities [5]. There are several main activities in the warehouse process including [6]: Pre-advice, Receiving, Checking, Put-away, Storage, Picking, Packing, Dispatch, Return, Value adding. Put-away and storage is the stage at which items that have gone through the checking process will be placed to the storage location. At the put-away stage, barcodes of goods that have gone through the checking process, are scanned to be inserted into the system and placed on shelves or pallets directed by the system. Next is the picking process using batch picking method which is a group of people assigned to take multiple order amounts at once in one trip [7]. After the picking process will then be continued with the packing process and value-adding according to the needs of the goods to be shipped. After that, the goods will enter the dispatch or delivery process. According to [4], there are 4 warehouse functions in supply chain activities, namely, First, Storage, The warehouse is used as a storage area for goods that can protect the item. The length of storage time can affect the layout of the warehouse. Second, Consolidation. The consolidated warehouse utilizes the space held for temporary storage that prioritizes the speed and ease of flow of goods. For example, cross docks and pool points so that products are moved directly from inbound to outbound without storage. Third, Break Bulk. Warehouse breakbulk is a warehouse that has distribution activities with inbound transportation costs cheaper than outbound transportation costs. So, consumer demand is smaller than the vehicle capacity. Fourth, Fulfilment Center. Warehouses serve as third parties that have several different e-commerce clients or delivery orders that have warehouses in the same place and use similar services. The process of fulfillment or fulfillment of orders starts from the request of goods from the customer, then the operator performs the pickup and packaging of the goods and is then distributed to the customer [8]. Warehouses receive inbound from many vendors then the volume of shipments of different types of goods is collected on one warehouse and then merged according to existing orders and subsequently shipped to consumers.

2.2. Forecast

In planning, warehouse expansion required data on the necessary capacity needs before deciding for the expansion of the storage needs of goods. With the forecast value based on the history of the number of goods received and stored in the warehouse, the company can do the planning to prepare the room to be used.

The double exponential smoothing method can be used for data that has levels and trends but has no seasonal patterns. In using the double exponential smoothing method, it is necessary to use α and β constants whose values are in the range of 0 to 1. In the period t is known to level (St) and trend (Gt), hence the formula to calculate the forecast of the next period uses the formula [9]:

\[
F_t = S_t + \tau.G_t
\]

Based on the request data in the period to t, two new equations are obtained:

\[
S_t = \alpha. D_t + (1-\alpha).(S_{t+1}+G_{t-1})
\]

\[
G_t = \beta (S_t - S_{t-1}) + (1-\beta). G_{t-1}
\]
In this calculation method, initial specifications are required to determine the $S_0$ and $G_0$ values. In this study used Holt methods.

2.3. Warehouse Space Planning
Planning the amount of warehouse capacity is often overlooked in terms of logistics. Poor warehouse management planning can cause financial impact due to problems related to material handling costs, damage to goods, time wasted to locate goods, storage costs, and unused warehouse space costs. Here are some important stages in planning warehouse capacity [10]:

- **Item level storage profile**
  The initial stage in calculating capacity is determining the dimensions, weight, and quantity of pallets or shelves to be used to store goods.

- **Warehouse storage capacities**
  Any type of storage such as pallets, boxes or shelves, must be listed in the system along with its location. Then each of these storage types must assign a storage volume based on the dimensions of space and storage capacity. The storage location will be determined based on the size and amount of stock of existing goods.

There are three strategies for capacity planning [11]:

1. **Lead Strategy**: Capacity building occurs when increased demand is anticipated. This strategy is aggressive because anticipating a surge in demand can therefore lead to excess space for storage to lead to additional costs.
2. **Lag Strategy**: New capacity is added if the space is already full without anticipating a surge in demand, this has a low risk of spending additional costs but can lead to the loss of potential service users.
3. **Match Strategy**: This strategy adds a small amount of storage capacity in reaction to demand. Space planning is an important stage in planning the expansion of storage space. This process aims to determine the storage capacity that companies need in meeting the demand for the services offered by increasing productivity, minimizing costs, and supporting increased sales.

2.4. Economic Engineering
AWA, Annual Worth Analysis is a technique that can be used to evaluate cash flow for a project and alternatives based on a specific period [12]. The concept of AWA is the profit or loss generated by an alternative project every single period. The use of the AWA method was chosen because both alternatives have different life ages and have monthly costs that need to be incurred. So the AWA method is more suitable to be used than present worth analysis (PWA) for alternative decision making that the company will choose.

3. Research Methodology

3.1. Step of research
1. **Formulation of Problems**
   The study conduct at Indonesia 3PL company's DGP, where the warehouse filling level is 98%, leaving 2% which is not enough when compared to the recent increase online seller orders in near future.
2. **Data Collection**
   The data collection by direct (interview, brainstorming, discussion) and indirect (online use email, google form, WhatsApp's message) during March to July 2020, both primary and secondary data, includes current warehouse capacity data, the number of goods stored in the current warehouse, and the current warehouse layout. The data retrieval of the maximum capacity of the warehouse currently aims to know the maximum number of goods that can be stored in the warehouse, then retrieve the data of the current amount of goods in the warehouse taken from the data warehouse management system (WMS) which aims to
determine the current warehouse occupancy. The warehouse layout is currently used to determine the location of the goods rack. DGP as 3PL warehouse and distribution center, majority handle fashion products with small dimensions and light weight. Referring to Kirk (2010), to maximize warehouse space could achieve by build mezzanine floors because the product is light in weight and the warehouse roof is quite high [13].

3. Data Processing

Data history storage will be processed into a forecast using Microsoft Excel with holt forecast method. The brainstorming to find out expansion option resulting second option to build mezzanine floor. The calculated the maximum capacity of two alternatives with warehouse space planning to determine the additional capacity that can be accommodated and the life span of each alternative. Based on that capacity will then be made a cost comparison based on warehouse expansion options using AWA.

4. Result and Analysis

The data needed to determine warehouse expansion is the total warehouse capacity data and the warehouse capacity that has been used based on the number of items stored in the warehouse. Table 1 is the warehouse area data currently used and the maximum warehouse capacity.

| Description                | Unit | Quantity |
|----------------------------|------|----------|
| Full Occupancies Capacities| Pieces | 1,023,300 |
| Total Space Area           | m$^2$ | 4,536    |
| Used Space Area            | m$^2$ | 4,056    |

Table 2 is the calculation results of Holt forecast, inbound (5% of storage) and outbound (7% of storage) as well as additional storage capacity needed for the period June 2020 to April 2022, show the capacity need is 1,227,960 pieces or increase 20%.

| Periode | Inbound 5% | Store excess stock | Outbound 7% |
|---------|------------|--------------------|-------------|
| Apr-20  | 17,658     | 0                  | 0           |
| Mei-20  | 0          | 0                  | 0           |
| Jun-20  | 96,504     | 96,504             | 6,755       |
| Jul-20  | 58,231     | 147,980            | 10,359      |
| Aug-20  | 61,836     | 199,457            | 13,962      |
| Sep-20  | 65,439     | 250,934            | 17,565      |
| Oct-20  | 69,041     | 302,410            | 21,169      |
| Nov-20  | 72,646     | 353,887            | 24,772      |
| Dec-20  | 76,249     | 405,364            | 28,375      |
| Jan-21  | 79,851     | 456,840            | 31,979      |
| Feb-21  | 83,456     | 508,317            | 35,582      |
| Mar-21  | 87,059     | 559,794            | 39,186      |
| Apr-21  | 90,662     | 611,270            | 42,789      |
| May-21  | 94,266     | 662,747            | 46,392      |
| Jun-21  | 97,869     | 714,224            | 49,996      |
| Jul-21  | 101,472    | 765,700            | 53,599      |
| Aug-21  | 105,076    | 817,177            | 57,202      |
4.1. Multi-tier Option

Based on measurements, for multi-tier alternatives the size of the area that can be used for the storage of goods is 1,312 $\text{m}^2$. The number of shelving or shelves that can be accommodated is as much as 1,190 shelves. The new warehouse rental alternative is used as a storage area of goods of 3,300 $\text{m}^2$ with the number of shelves that can be accommodated as many as 2,339 shelves. Each shelf can hold 15 mobile bins or boxes. Each mobile bin can accommodate 35 pieces of goods. So for the alternative addition of multi-tier additional capacity obtained 624,750 items. As for the alternative addition of new warehouse additional capacity obtained 1,227,960 items. Of the additional capacity amounts of both alternatives, it can determine the age of use of both alternatives before determining the next warehouse expansion. Based on the estimated value of the amount of stock to be stored in the DGP’s warehouse, for alternative multi-tier additions can be used for 11 months and for alternative additions new warehouses can be used for 23 months. After determining the life span, then make a comparison based on the cost of the initial cost, operating cost, and lifetime. Based on the results of the maximum storage cap calculation comparison, the life span before the company has to find new alternatives to accommodate existing storage needs, installation costs, total monthly costs, the profit that the company will get after making fulfilment service offerings, and analysis using AWA method.

Table 3 is a table of cost components required for the construction and installation of a multi-tier storage area.

![Figure 1. Design Layout Multi-Tier](Figure1.png)
Table 3. Components of Multi Tier Cost

| No | Item                      | Qty | Cost, IDR          | Total Cost , IDR |
|----|---------------------------|-----|--------------------|-----------------|
| 1  | Construction cost         | 1   | 6,204,350,000.00   | 6,204,350,000.00|
| 2  | Lift                      | 1   | 40,000,000.00      | 40,000,000.00   |
| 3  | Gravity Conveyor          | 1   | 30,000,000.00      | 30,000,000.00   |
| 4  | Trolley                   | 6   | 1,000,000.00       | 6,000,000.00    |
| 5  | Desk                      | 6   | 920,000.00         | 5,520,000.00    |
| 6  | Chair                     | 4   | 400,000.00         | 1,600,000.00    |
| 7  | Packing Desk              | 3   | 1,500,000.00       | 4,500,000.00    |
| 8  | Bin mobile                | 24  | 150,000.00         | 3,600,000.00    |
| 9  | Printer                   | 2   | 2,500,000.00       | 5,000,000.00    |
| 10 | Barcode Printer           | 4   | 2,000,000.00       | 8,000,000.00    |
| 11 | Barcode Scanner           | 4   | 480,000.00         | 1,920,000.00    |

4.2. New Warehouse Option

A new warehouse is one option in expanding the warehouse. The cost required for renting a new warehouse with an area of 4,056 m² is IDR 365,583,504.00 per month. Meanwhile, the cost required to set up a new warehouse whose layout is exactly the same as the current warehouse is IDR 6,535,730,437.98 which includes the costs of installing shelving racks and other initial installations, as well as the cost of equipment for goods mobility required trolley and bin mobile (Table 4).

Table 4. Comparison set up cost between two options

| No | Usage (months) | Month | Initial Cost | Rp  6,535,730,437.98 Expenses | Initial Cost | Rp  6,301,490,000.00 Expenses |
|----|----------------|-------|--------------|-------------------------------|--------------|--------------------------------|
| 1  | Jun-20         | Rp    | 581,454,830.66 | 1                             | Jun-20       | Rp 108,570,096.55             |
| 2  | Jul-20         | Rp    | 578,358,633.43 | 2                             | Jul-20       | Rp 125,785,200.70             |
| 3  | Aug-20         | Rp    | 595,874,457.92 | 3                             | Aug-20       | Rp 149,176,015.21             |
| 4  | Sep-20         | Rp    | 618,703,756.43 | 4                             | Sep-20       | Rp 171,872,322.81             |
| 5  | Oct-20         | Rp    | 629,776,213.72 | 5                             | Oct-20       | Rp 182,811,791.78             |
| 6  | Nov-20         | Rp    | 647,317,159.68 | 6                             | Nov-20       | Rp 200,219,746.83             |
| 7  | Dec-20         | Rp    | 657,448,363.00 | 7                             | Dec-20       | Rp 210,217,959.25             |
| 8  | Jan-21         | Rp    | 681,018,090.26 | 8                             | Jan-21       | Rp 245,670,660.02             |
| 9  | Feb-21         | Rp    | 697,495,282.20 | 9                             | Feb-21       | Rp 262,014,861.05             |
| 10 | Mar-21         | Rp    | 715,907,500.81 | 10                            | Mar-21       | Rp 280,294,088.76             |
| 11 | Apr-21         | Rp    | 726,251,985.88 | 11                            | Apr-21       | Rp 290,505,585.51             |
| 12 | May-21         | Rp    | 749,340,707.91 | 12                            |              |                                |
| 13 | Jun-21         | Rp    | 767,350,202.56 | 13                            |              |                                |
4.3 AWA calculation
In the AWA calculation (Table 5), the bank loan interest used is 9.95% per year based on the Financial Services Authority Credit Base Rate (Otoritas Jasa Keuangan, 2020) at the position of the end of May 2020, so the monthly interest generated is 0.83%.

| No | Period | Cost, IDR         | Revenue, IDR         | Cost-Revenue, IDR         |
|----|--------|-------------------|----------------------|---------------------------|
| 1  | Jun-20 | 7,117,185,268.64  | 147,650,000.00       | 6,969,535,268.64          |
| 2  | Jul-20 | 578,358,633.43    | 103,366,500.00       | 474,992,133.43            |
| 3  | Aug-20 | 595,874,457.92    | 167,548,250.00       | 428,326,207.92            |
| 4  | Sep-20 | 618,703,756.43    | 198,432,500.00       | 420,271,256.43            |
| 5  | Oct-20 | 629,776,213.72    | 161,277,250.00       | 468,498,963.72            |
| 6  | Nov-20 | 647,317,159.68    | 260,205,750.00       | 387,111,409.68            |
| 7  | Dec-20 | 657,448,363.00    | 291,090,000.00       | 366,358,363.00            |
| 8  | Jan-21 | 681,018,090.26    | 219,188,000.00       | 461,830,090.26            |
| 9  | Feb-21 | 697,495,282.20    | 352,863,250.00       | 344,632,032.20            |
| 10 | Mar-21 | 715,907,500.81    | 383,751,500.00       | 332,156,000.81            |
| 11 | Apr-21 | 726,251,985.88    | 277,099,750.00       | 449,152,235.88            |
| 12 | May-21 | 749,340,707.91    | 445,520,750.00       | 303,820,957.91            |
| 13 | Jun-21 | 767,350,202.56    | 476,409,000.00       | 290,941,202.56            |
| 14 | Jul-21 | 776,584,710.05    | 507,293,000.00       | 269,291,710.05            |
| 15 | Aug-21 | 794,574,603.53    | 538,178,250.00       | 256,396,353.53            |
| 16 | Sep-21 | 804,615,667.41    | 569,065,250.00       | 235,550,417.41            |
| 17 | Oct-21 | 835,940,327.30    | 592,922,250.00       | 243,018,077.30            |
| 18 | Nov-21 | 845,816,480.07    | 630,835,750.00       | 214,980,730.07            |
| 19 | Dec-21 | 862,896,918.27    | 661,722,750.00       | 201,174,168.27            |
| 20 | Jan-22 | 905,696,143.89    | 692,609,000.00       | 213,087,143.89            |
| 21 | Feb-22 | 954,861,149.22    | 723,497,250.00       | 231,363,899.22            |
| 22 | Mar-22 | 961,826,734.00    | 754,381,250.00       | 207,445,484.00            |
| 23 | Apr-22 | 1,012,310,408.74  | 783,979,000.00       | 228,331,408.74            |

**NPV**

IDR 13,524,414,217.73

**AWA**

- IDR 648,296,200.66
Table 6. Calculation of AWA Multi-tier option

| No | Period   | Cost, IDR       | Revenue, IDR    | Revenue, IDR |
|----|----------|-----------------|-----------------|--------------|
| 1  | Jun-20   | 6,410,060,096.55 | 147,650,000.00  | 6,262,410,096.55 |
| 2  | Jul-20   | 125,785,200.70   | 103,366,500.00  | 22,418,700.70 |
| 3  | Aug-20   | 149,176,015.21   | 167,548,250.00  | -            | 18,372,234.79 |
| 4  | Sep-20   | 171,872,322.81   | 198,432,500.00  | -            | 26,560,177.19 |
| 5  | Oct-20   | 182,811,791.78   | 161,277,250.00  | -            | 21,534,541.78 |
| 6  | Nov-20   | 200,219,746.64   | 260,205,750.00  | -            | 59,986,003.17 |
| 7  | Dec-20   | 210,217,959.25   | 291,090,000.00  | -            | 80,872,040.75 |
| 8  | Jan-21   | 245,670,660.02   | 219,188,000.00  | -            | 26,482,660.02 |
| 9  | Feb-21   | 262,014,861.05   | 352,863,250.00  | -            | 90,848,388.95 |
| 10 | Mar-21   | 280,294,088.76   | 383,751,500.00  | -            | 103,457,411.24 |
| 11 | Apr-21   | 290,505,585.51   | 277,099,750.00  | -            | 13,405,835.51 |

NPV: 5,934,022,360.96
AWA: 566,663,848.42

In the new warehouse rental option, the period of use is for 23 months, then the value of AWA or the amount of fees incurred by the company each month is IDR 648,296,200.66. In the multi-tier addition to the current warehouse option (Table 6), the period of use is 11 months, then the value of AWA or the amount of costs incurred by the company each month if deciding to choose an alternative multi-tier addition is IDR 566,663,848.42.

4.4 Discussion result

Table 7. Cost comparation between two option

| Description               | New warehouse rental | Multi Tier          |
|---------------------------|----------------------|---------------------|
| Max capacity storage      | 1,227,960            | 624,750             |
| Service Life              | 23 months            | 11 months           |
| Setup cost                | 6,535,730,437.98     | 6,301,490,000.00    |
| AWA value                 | 648,296,200.66       | 566,663,848.42      |
| Total Ops. monthly cost   | 17,401,420,26.94     | 2,227,138,328.49    |
| Total Revenue cost        | 9,738,886,250.00     | 2,562,472,750.00    |

Based on Table 7, in the new warehouse rental option, the total operational cost will be incurred during the useful life of IDR 17,401,420,326.94, while for the multi-tier manufacturing option is more low IDR 2,227,138,328.49. In the new warehouse rental, the projected income to be received is IDR 9,738,886,250.00, while in the multi-tier option, is IDR 2,562,472,750.00. To make a new warehouse, it has an AWA value of IDR 648,296,200.66 with a service life of 23 months, while multi-tier warehouse has an AWA value of IDR 566,663,848.42 with a life of 11 months. The difference in AWA between the alternative of building a new warehouse and making a multi-tier is IDR 81,632,352.24 or 12.6% more lower.

Based on the AWA value analysis, DGP shall choose an alternative for making a multi-tier warehouse because it has a lower AWA value compared to making a new warehouse. Renting a warehouse is more expensive because DGP has to pay rental cost for a new warehouse and additional security costs every month, while the option to create a multi-tier warehouse will use the same location, namely using an existing warehouse and utilize human resources for existing security at the existing warehouse. With a note, before the eleventh month DGP should prepared a new warehouse location.
5. Conclusion

Based on data collection, data processing and analysis, the following are the conclusions of the research conducted. First, current warehouse occupancy is 98%. Currently there are 1,023,300 items stored in DGP’s warehouse and the maximum storage capacity for the warehouse is currently 1,023,300 items. In April 2022, the additional capacity required is 1,227,960 units on 20% increase. Second, comparison of the two alternatives based on initial costs and operational costs. The cost comparison method used is the Annual Worth Analysis (AWA). In the new warehouse lease alternative, the AWA value is IDR 648,296,200.66. In the alternative of adding a multi-tier to the current warehouse, the AWA value obtained is IDR 566,663,848.42 or 12.6% lower. Third, The decision between the two alternatives is determined based on the AWA value or the amount of costs incurred by the company every month. In the alternative, the addition of multi-tier is IDR 566,663,48.42 which has a lower monthly expenditure cost than the alternative for leasing a new warehouse.

Suggestions for DGP, first, the company chooses a multi-tier addition alternative to its current warehouse expansion. And Second, the company should recalculate the warehouse storage space requirement in Q4 2020 for the next warehouse expansion plan.

References
[1] Dieu Ho T H, Daniel J, Nadeem S P, Garza-Reyes J A and Kumar V 2019 Improving the reliability of warehouse operations in the 3PL Industry: an Australian 3PL case study
[2] Zhang J, Nault B R and Tu Y 2015 A dynamic pricing strategy for a 3PL provider with heterogeneous customers International Journal of Production Economics 169 31-43
[3] Sivakumar V and Rutheramathi R 2019 Challenges and Features of Warehousing Operations With Respect to Logistics Warehouse Companies in Chennai International Journal of Innovative Technology and Exploring Engineering (IJITEE) 9 3304-08
[4] Garside A K and Rahmasari D 2017 Logistics Management Malang: UMM Press
[5] Guo X, Yu Y and Koster R B 2016 Impact of Required Storage Space on Storage Policy Performance in a Unit-Load Warehouse International Journal of Production Research 54 (8) 2405–18
[6] Richards G 2017 Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse Third Edition United Kingdom: Kogan Page Limited
[7] Shah B and Khanzode V 2017 A Comprehensive Review of Warehouse Operational Issues International Journal of Logistics Systems and Management (IJLSM) 26(3) 346-78
[8] Zhang Y and Khan S A 2017 Importance of Warehouse Layout in Order Fulfiling International Journal of Transportation Engineering and Technology 3(4) 49-52
[9] Chopra S and Meindl P 2013 Supply Chain Management: Strategy, Planning, and Operations 5th Edition New Jersey: Prentice Hall
[10] Ross D F 2015 Distribution Planning and Control : Managing in the Era of Supply Chain Management 3rd Edition New York: Springer-Verlag New York Inc
[11] Hazari S and Sohani D N 2017 Capacity Planning and Layout Optimization International Journal of Scientific Engineering and Research (IJSER) 5 152-7
[12] Al-Odeh D M 2019 Economics and Cost Analysis for Operations and Project Managers New York: Rylan Books
[13] Kirk O 2010 Planning for a Warehouse System Upgrade?. MHD Supply Chain Solutions 40(2) 26