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INNOVATIVE PROCESS METHOD FOR OPTIMIZATION OF LOGISTICS

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Abstract: This thesis makes a cost benefit analysis of relocating the outdated and supply of goods from distribution center of the warehouse. Given the dynamic environment surrounding the warehouse operations, logistic sustainability requirements, rapid information technology developments, and budget-constrained the site selection of a supply distribution center is critical to the future operations and logistics supporting. Additionally, this thesis analyzes site selection alternatives through the use of the Center of Gravity Method (Rectilinear Distance). The results of the analysis indicate that the most advantageous location for the supply center.

I. INTRODUCTION

Warehousing has been a part of civilization for thousands of years. Warehousing is the function of storing goods between the time they are produced and the time they are needed. In practice, goods are sent to storage points close to the market and are issued to consumers from these points easily and in small amounts when needed. Although warehousing was initially a means of storing foodstuffs, today it is a broad and complex issue. For example, there are more than 300,000 large warehouses and 2.5 million employees in the United States alone. A warehouse is a distribution factory. The warehousing functions far exceed the mere provision of a building to protect the stored goods from the elements. Furthermore, any warehouse is a complex, constantly evolving center, which must be able to cope with a myriad of expansions and expectations and must do so cost effectively. Adequate space, customer service, favorable traffic connections with suppliers and key markets, easy freeway access, proximity to trains and airports and a qualified work force–these are only some of the factors that a warehousing study must evaluate. In order to succeed in certain demand areas, organizations must have a warehouse presence. Naturally, capital investment, operating expenses, and customer service are all affected by decisions regarding site and structure. As a result, storage should be considered as a resource. Investments in storage facilities should be identified through an initial study and must be followed by a feasibility analysis. The location of warehousing must be studied carefully prior to undertaking the other complex issues inherent in a storage study. Before a site is selected, all management levels and business entities must participate in the analysis. Unfortunately, warehouse location projects frequently are understaffed, under-funded, and fail to consider fully the entire distribution network's current capabilities and future requirements. The process of selecting a site requires a clear understanding of the underlying strategy to be developed and must communicate this research to all the stakeholders involved. Obtaining buy-in from all levels and departments of the organization to ensure a successful analysis and decision is necessary. Warehouse design begins with determining the best warehouse location. The design process also includes the layout, storage methods, equipment and automated systems, source and nature of the supplies, zones, and order receiving methods. Clearly, owing to its complexity, site selection is one of the most challenging and important responsibilities of logistics managers. The task of site selection literally involves art as well as science. Site selection has a major impact on logistics costs and operational efficiency. A warehouse poorly located can deal a costly and even a mortal blow to the life of an organization heavily involved in physical distribution. The site selection process begins at the highest strategic (macro) level and descends until a specific real estate parcel is chosen. Then the site selection process usually involves weighing priorities, determining the critical features, and eliminating inadequate sites. Since every location has advantages and disadvantages, the final selection of a site is likely to involve some compromises.

The first step to consider is asking why one is seeking a new warehouse site. The following are three common reasons:

- Relocating to an existing warehouse operation is necessary.
- Inventory must be moved to a new location due to expanding responsibilities.
- Additional warehouse space is needed to accommodate a growing inventory.

Depending on which of the above reasons is the primary motive for seeking a new warehouse, the site search can assume many different forms.

Purpose: The purpose of this research is to find the best logistics supply center location for the warehouse so that it can perform its mission better and can capitalize on the latest technological developments.

II. LITERATURE REVIEW

This section provides a review of academic literature related to the field of the present investigation. The focus of our analysis within Reverse Logistics is on distribution and inventory management, as being logistics core elements. Literature on both of these areas is discussed in detail in the subsequent chapters in the course of the analysis. At this point, we take a broader perspective and consider literature complementing our research. For this purpose, we review scientific literature concerning general Reverse Logistics issues which mainly have a conceptual and structuring character. In addition, we discuss insights from business areas that have a direct interface with logistics and thereby determine its boundary conditions. To this end, we consider related literature on marketing channels, on the one hand, and on production and operations management, on the other hand. Given the direction of our research, the focus is on quantitative analyses. In addition, we include literature sources that provide points of reference by structuring major issues, and qualitative case descriptions that may serve as a basis for a quantitative analysis.

Jayaraman et al. (2003) propose a model framework on reverse distribution problems in order to minimize costs to transfer products from origins through collection sites to their destinations and fixed costs of opening the collection and destination sites. They develop a strong and a weak formulation for reverse distribution problems that include product recall, product recycling and reuse, product disposal and hazardous products return. Ko and Evans (2007) develop a mixed integer nonlinear programming model for an integrated distribution problem which simultaneously considers forward and return network. They apply a genetic algorithm-based heuristic and compare it with an exact algorithm on a set of problems. Du and Evans (2008) present a bi-objective optimization model which minimizes the total costs as well as the total tardiness. They develop a solution approach that consists of a combination of three algorithms: scatter search, dual simplex and constraint method. It has been published that encompass research on Reverse Logistics. However, most of them have a different focus and include Reverse Logistics as one sub {aspect rather than a major theme on its own. Many of the sources referred to in this thesis are discussed in the review by Fleischmann et al.(1997) (11) addressing Operational Research (OR) models in a Reverse Logistics context. The material is structured around the areas of distribution management, inventory control, and production planning. Vidaland Goetschalckx (1997) identifies several lacking features and opportunities for research in the methodology for the strategic and tactical design of global logistics systems. Much of the research ignores relevant international factors such as transportation mode selection, the allocation of transportation cost among subsidiaries, the inclusion of inventory costs as part of the decision problem, the explicit inclusion of suppliers, and the nonlinear effects of international taxation. There exist many papers on quantitative techniques for the improvement and optimization of supply chains without global considerations, and mixed integer programming models are among the most widely used techniques. Most models address the problem in a regional, local, or single-country environment, where international factors do not have a significant impact on the design of the supply chain. We will also use the term ‘domestic’ to indicate these single-country models.

III. RECTILINEAR DISTANCE AND LINEAR DISTANCE (CENTER OF GRAVITY METHOD)

As stated before, the Center of Gravity Method is based on minimizing the total transportation costs. Doing this, the Center of Gravity Method makes two assumptions about the transportation costs:

- Transportation cost is the only factor when selecting a site,
- Transportation cost changes proportionally to the transportation distance.

The following data must be known to compute the coordinates of the best location that minimizes the transportation costs:

- The amount of cargo to be transported to all customer locations,
- The geographic coordinates of all locations on a specific grid system,
- The unit transportation costs.

The mathematical notations of the variables are as follows:

$P_i (X_i; Y_i)$: The coordinates of the customer location i.

T (X; Y): The coordinates of the best location.

D $(T\text{-}P_i)$: The distance between location T and $P_{i,}$ (km).

Ci: The transportation cost to carry one unit load to one unit distance between T and Pi, (Cost/kg*km).

Qi: The amount of load to transport between T and Pi, (kg).

N: The number of customer locations.

TC: The total transportation cost.

The objective function is defined as below:

TCmin = [C*ni*1i * Qi * d (T-Pi)]. (1)

The objective of this method is finding the coordinates of the location T (X; Y) that minimize the total transportation costs. Ci, Qi and n are constant values. The only variable is the distance: d (T-Pi). The distance can be calculated in three different ways:

A. Rectilinear Distance

Used for ground transportation when a rectilinear street network or aisle network needs to be considered. The rectilinear distance between the best location and the customer locations is calculated as follows:

d (T-Pi) = |X – Xi| + |Y – Yi|. (2)

Calculation with the Rectilinear Distance

$W_i$is the transportation cost of carrying the entire load of customer “i” (P_i) to one unit distance between T and P_i. In short, “W_i” will be called “the weighted load values” and represented with the following formula:

$W_i= C_i* Q_i$. (3)

The formula for the total transportation cost is below:

TC = Σ[W=ni1_i * (|X – X_i| + |Y – Y_i|)]

TC = Σ(W=ni1_i*|X – X_i|) + (WΣ=ni1_i*|Y – Y_i|)

TC = Min f (x) + Min f (y).

f (x) is the total cost of transportation in the x-direction and f (y) is the total cost of transportation in the y-direction. Thus the minimum total cost can be obtained by solving the two independent problems of minimizing the cost of transportation in the x-direction and minimizing the cost of transportation in the y-direction.

The X and Y values minimizing both functions are obtained from the following formulas:

The largest cumulative sum of $W_i$value < ½ * ΣW=ni1_i (4)

And The smallest cumulative sum of $W_i$value ≥ ½ *

$W\Sigma=ni1_i$. (5)

W_m is the cumulative weighted load value (cumulative sum of W_i) that satisfies the inequalities of (6) and (7). When W_m is greater than the median (½ * $W\Sigma=ni1_i$), the coordinates of the best site are the X and Y median values, which belongs to the W_m value (m^{th} X value=X_m and m^{th} Y value=Y_m). If W_m is equal to the median, then these coordinates are expressed as an interval: [X_m, X_{m+1}] or [Y_m, Y_{m+1}]. An example of the calculation is explained later in this chapter.

The following steps are used to determine the best location:

• Create a data table to find the abscissa (X) and another table to find ordinate (Y) of the best location,
• Sort ascending the abscissa and ordinates of the demand centers,
• Calculate the W_i ($C_{i*}Q_i$) value of the customer locations,
• Calculate the cumulative sum of W_i values and list in a column on the data table,
• Calculate ΣW_i (the total of all weighted load values),
• Calculate the median (½ ΣW_i) value,
• Find the number that is equal to the (½ ΣW_i) from the cumulative sum of W_i column. If the (½ ΣW_i) value does not exist in the cumulative sum of W_i, then find the number that is closest in value to the (½ ΣW_i) but greater than (½ ΣW_i).

The abscissa and ordinate values in these rows give the point T (X; Y), which minimizes the total transportation costs.

Rectilinear and square linear problem: Command to minimize the transportation costs, the rectilinear distance and the square of the linear distance methods must be used to find the best location.

Table 1: Summary of Example

Location	Coordinate	Annual Load (Q_i– kg)	Cost (C_i– TL/kg*km)
Maharashtra	P_1(3; 4)	40000	5
Punjab	P_2 (3; 10)	30000	10
Meerut	P_3 (8; 2)	10000	10
Utarakhand	P_4 (10; 10)	30000	9
Chennai	P_5 (14; 6)	10000	7
Guwahati	P_6 (14; 7)	20000	5
Tamilnadu	P_7 (16; 6)	20000	7

The goal is finding the coordinates of the best location for the Logistic Center Command that minimizes the total transportation costs.

TC_{min} = [$C\Sigma=ni1_i$ * Q_i * d (T-P_i)].

W_i = C_i * Q_i.

B. Solution to the Rectilinear Distance Situation: The following table must be formed to find the best location. The coordinates of the best location are designated in Table 1.

Table 2: Calculation of the Best Location with the Rectilinear Distance

ABSCISSA X_0=[8,10]					
Location	X_i	C_i (TL)	Q_i (x1000Kg)	W_i	Cumulative Sum of W_i
Maharashtra	3	3	40	200	200
Punjab	3	3	30	300	500
Meerut	8	10	10	100	600=1/2*1200
Utarakhan	10	9	30	270	870
Chennai	14	7	10	70	940
Guwahati	14	6	20	120	1060
Tamilnadu	16	7	20	140	$\sum W_i$=1200
ORDINATE Y_0=7					
Location	Y_i	C_i (TL)	Q_i (x1000Kg)	W_i	Cumulative sum of W_i
Meerut	2	10	10	100	100
Maharashtra	4	5	40	200	300
Tamilnadu	6	7	20	140	440
Chennai	6	7	10	70	510<1/2*1200
Guwahati	7	6	20	120	630>1/2*1200
Punjab	10	10	30	300	930
Uttarakhand	10	9	30	270	$\sum W_i$=1200

The abscissa table is in ascending abscissa (X_i) order, and the ordinate table is in ascending ordinate (Y_i) order in Table 3.2. The sum of W_i(ΣW_i) is 1,200 and the median value of cumulative sum is:

½*ΣW_i=600.

Since the median value (½*ΣW_i=600) exists in the cumulative sum of W_i column of the abscissa table, the abscissa of the best location will be expressed within an interval. The abscissa value on the corresponding row is the lower limit of the interval (X_i=8) and the upper limit is the X_i=10, which must be adjacent to and greater than the lower limit of the interval (10>8). Consequently, the abscissa of the best location is any value within the interval of. The median value (½*ΣW_i=600) does not exist in the cumulative sum of W_i column of the ordinate table. Therefore, the smallest number, which is greater than the median value (½*ΣW_i=600), must be chosen and this number is 630. Consequently, the ordinate of the best location is Y_i=7, which is the corresponding ordinate value on the same row with the value of 630. For example T (8; 7) is one of the best location coordinates, and the total transportation cost for this point is

$TC = \Sigma [W_i * (|X - X_i| + |Y - Y_i|)]$

TC = (200 * |8–3| + 300 * |8–3| + 100 * |8–8| + 270 * |8–10| + 70 * |8–14| + 120 * |8–14| + 140 * |8–16| + 100 * |7–2|+ 200 * |7–4| + 140 * |7–6|+ 70 * |7–6| + 120 * |7–7| + 300 * |7–10| + 270 * |7–10|) * 1000 TL

TC = (1000 + 1500 + 0 + 540 + 420 + 720 + 1120 + 500 + 600 + 140 + 70 + 0 + 900 + 810) * 1000 = 8,320,000 TL (The minimum).

The total cost value remains the same for all the abscissa values within the interval limits. Total cost is 8,320,000 TL for all T (X; Y)= T (8; 7), T (9; 7), and T (10; 7) coordinates; therefore all of these locations are the suitable locations.

IV. CONCLUSION

The centre of gravity method the best location by minimizing transportation cost. The only variable in this method is the distance. There are three different distance calculation method under the centre of gravity method. However, only the rectilinear and square of linear distance method are applied in this case study. Since there are more appropriate in warehouse site selection problems. The data used in this method is the transport data presented in location Maharashtra, Punjab, Meerut, Uttrakhand, Chennai, Guwahati, and Tamilnadu. The centre supposes the local command and transport material to other logistics common in region. The centre of gravity method is used to solve multi-criteria problem. Formally an inter-discipline of committee is highly recommended for the centre of gravity method. The centre of gravity method can present most of the drawback of decision making process. The total cost value remains the same for all the abscissa values within the interval limits. Total cost is 8,320,000 TL for all T (X; Y)= T (8; 7), T (9; 7), and T (10; 7) coordinates; therefore all of these locations are the suitable locations. Consequently the coordinates of the best location, which minimizes the transportation costs is T (X; Y) = T (8.25; 7.33).

REFERENCES

[1] Defense Technical Information Center Ft. Belvoir, VA
[2] Dudley Knox Library Naval Postgraduate School Monterey, CA
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[8] Jayaraman, V., R.A. Patterson, E. Rolland. 2003. The design of reverse distribution networks: Models and solution procedures. European Journal of Operational Research 150 128-149.
[9] Cohen, M.A., Kleindorfer, P.R., 1993. Creating value through operations: The legacy of Elwood S.Buffa.In: Sarin, R.K. (Ed.), Perspectives in Operations Management (Essays in Honor of Elwood S.Buffa). Kluwer Academic Publishers, Boston, pp.3–21.
[10] Du and Evans (2008) A bi-objective reverse logistics network analysis for post-sale service.
[11] Fleischmann et al.(1997) Whole-genome random sequencing and assembly of Haemophilus influenzae rd. Science 269, 496-512.
[12] Vidal C. and Goetschalckx, M. (1997), "Strategic Production-Distribution Models: A Critical Review with Emphasis on Global Supply Chain Models", European Journal of Operational Research, Vol. 98, pp. 1-18.

