

International Journal of Advanced Research in Computer Science

RESEARCH PAPER

Available Online at www.ijarcs.info

Applying Wall Layer Building Algorithm for Optimizing the Equal Dimension Boxes in Vehicle Load Filling

J. Sheik Mohamed* Asst. Professor, MCA Department SITAMS, Chittoor, A.P., India Sheik_50@yahoo.co.in

Dr. S. Sreekanth Professor & Director Department of MCA SITAMS, Chittoor, A.P., India B. Narendra Babu MCA Department SITAMS, Chittoor, A.P., India bnarendra781@gmail.com

Dr. N. Ch. S. N. Iyengar Sr. Professor School of Computing Science & Engineering VIT University, Vellore, T.N. India

Abstract: In today's global markets, enterprises are integrated in order to produce value for the end customers. Logistics optimization is the biggest opportunity for most companies to significantly to satisfy the customer. It is the integration of information, transportation, inventory, warehousing, material handling, packaging and security. Transportation management is one of the main process in Logistics world. Transportation management include, among others, load planning and delivery route planning. In the existing logistics business process, the load planning was established for different types of boxes in order to minimize the wastage of space or maximum utilization of vehicle space. But there is no procedure or method to load similar type of boxes into vehicle with maximum utilization of space. This approach establishes or evaluates the load optimization for similar type of boxes by selecting the vehicle from availability. The load optimization is done for similar type of boxes using three algorithms, one algorithm gives the best optimal solution for load filling.

Keywords: Load Optimization, Vehicle Parameters, Space Utilization, Logistics.

I. INTRODUCTION

Logistics optimization is the biggest opportunity for most companies to significantly to satisfy the customer. It is the integration of information, transportation, inventory, warehousing, material handling, packaging and security. In logistics, transportation includes load and route optimizations. The load optimization is handled in the form of different type of boxes. But for Similar type of boxes how to optimize the load in a selected vehicle. So it is proposed to use three algorithmic approaches, which one of the algorithm minimize the unused space and optimize the load in the vehicle. The main objective of this approach is to optimize the load with similar type of boxes for the selected vehicle.

II. RELATED WORK

Logistics deals with the planning and control of material flows and related information in organizations, both in the public and private sectors. Broadly speaking, its mission is to get the right materials to the right place at the right time, while optimizing a given performance measure (e.g. minimizing total operating costs) and satisfying a given set of constraints (e.g. a budget constraint). In the military context, logistics is concerned with the supply of troops with food, armaments, ammunitions and spare parts, as well as the transport of troops themselves. Container loading problems may be grouped in different ways [2]. A basic distinction exists between cases in which a given set of goods has to be loaded completely and cases which allow some goods to be left behind [2].

The algorithms for the single and multiple container loading problems, use the algorithm for pack a certain amount of boxes of a single type onto a given surface. There are two basic approaches used to solve the single container loading problem [2]. These methods are based on wall-building and layer-building. The wall-building approach constructs vertical walls across the container(height wise), while the layer-building approach(Width wise) builds the loading plan layer by layer. There are two main container loading problems. The problem is to load the entire or part of the consignment into a single container.

The objective is to maximize volume utilization or to minimize the unused container volume. The second problem is to load the entire consignment into one or more containers. The objective is to minimize the number of containers used. We adopt the following notation, the container has length L, width W and height H; the n types of boxes are denoted as Box 1, Box 2, ..., Box n, while each box type i has dimensions li, wi, hi.

The transportation cost is calculated by considering several parameters [2]. The parameters are which influencing the cost. Mainly the parameters include which source, which destination, number of km need to transport, the capacity of truck, mileage of truck, labors for load and unload the goods, availability of trucks, cost of diesel and traffic [6]. The loading constraints are also influencing the transportation cost, which less than truck load and truck load, the arrangement of goods in truck, wastage of space in truck. The operation of Transportation determines the loading of goods and vehicle routing. It determines the efficiency of moving products [7]. The progress in techniques and management principles improves the moving load, delivery speed, service quality, operation costs, the usage of facilities and energy saving. Transportation takes a crucial part in the manipulation of logistics [7].



Figure. 1 Vehicle with load

III. **PROBLEM DESCRIPTION**

In logistics, for loading goods into the vehicles is very complex. Here the goods are packed in boxes (different dimensions) and loaded into the vehicle without eliminate the unused space. And there is no specific method or approach for loading the similar type of boxes into the vehicle. So we proposed to use three algorithmic approaches in which one of them minimizes the unused space.

IV. **PROBLEM ARCHITECTURE**

In this approach, the ordered customers are taken based on booking date when the goods are available. After orders selection, the total goods weight and tonnage of the vehicle is compared, from this the suitable matching vehicle is selected. And then the boxes are best fitted in to the vehicle based on the evaluation of three algorithms. From each algorithm the number of boxes fitted are vary. Among three algorithms, one algorithm gives most boxes loaded, one gives less boxes like wise. So based on these three algorithms, the best load fitting can be found out. In these three algorithms the length, width, height of the boxes are changed according to the type of algorithm.



Figure. 2 Problem Architecture

V. PROPOSED ALGORITHM AND ANALYSIS

In each algorithm, there are 3 steps,

Algorithm Analysis: **A**.

In each algorithm, there are 3 steps,

Initialization of parameters a.

```
b.
     Interchanging of box parameters
     Load fitting
Step 1: Initialize parameters
1. No. 2. LV 3. LBASE 4. BV 5. BBASE
6. HV 7. HBASE 8. lb 9. bb 10. hb 11. l
12. b 13. h 14. TGW 15. TT
Step 2: Interchange parameters
For General Algorithm
              2. bb = b
1. lb = 1
                                 3. hb = h
For L & W Algorithm
1. lb = b 2. bb = 1
                          3. hb = h
For L & H Algorithm
1. lb = h 2. bb = b
                          3. hb = 1
Step 3: Repeat Step 4 until i<No, where i=0
Step 4: if(hb[i] <= HV)
                 if(bb[i] \le BV)
                     if(lb[i] \le LV)
                      L\dot{V} = LV-lb[i];
                      box = box+1;
                        }
                      else
                    BV = BV-bb[i];
                   LV = LBASE;
                   i = i - 1;
                     }
                           }
                else
               BV = BBASE;
               LV = LBASE;
               HV = HV - hb[i];
               i = i - 1;
               }
                  }
            else
           { break; }
```

Figure. 3 Wall Layer Algorithm

В. **Explanation**:

a. Initialization of Parameters:

In this step, the box and vehicle parameters are initialized. The parameters includes,

lb = box length,

bb = box bredth,

- hb = box height,
- LBASE = vehicle length,
- BBASE = vehicle bredth,
- HBASE = vehicle height,
- No = no of boxes to be loaded,
- tg = Total goods weight.

Interchange of box Parameters: b.

In General Alg, the box parameters are not interchanged. That is lb, bb and hb are same.

In L & W Alg, the box parameters lb is interchanged as bb and bb is interchanged as lb, the hb is initialized as hb.

In L & H Alg, the box parameters lb is interchanged as hb and hb is interchanged as lb, the bb is initialized as bb.

Load Fitting: с.

In this step the box parameter lb, bb and hb are compared with vehicle parameters. Based on the comparison, the boxes are loaded into the vehicle.

VI. IMPLEMENTATION AND DISCUSSION

The following are the screen shots which shows the simulated results of the proposed algorithms

LOGISTICS	LOAD OPTIMIZATION (For Manufacturing Companies)	
OverView Item Parameters Add Diseav Package Box Parameters Add Diseav Order Goods Add Diseav Cancel Truck Details Add Diseav Load Optimization Sevelaped By B. NARENDRA BABU	DISPLAY ITEM PARAMETERS	
distant acontonom (1) men	ante d	

LOGISTICS LOAD OPTIMIZATION



Figure. 4 Required item wise parameters

This screen is used to add the parameter for every item such as name of the item and measures(weight) of that item which is required for filling the load by calculating the total weight for that item based on individual measures and further it compares this total weight with total tonnage capacity of the selected vehicle. It is also used to display the parameters for the existing items.

. .

LOGISTICS LOAD OPTIMIZATION

Item Parameters Add Display	Choose from Name		
ickage Box Parameters	Choose from Name		
ickage Box Parameters		Surflower of V Retrieve	
	ingh	ii) (n	
Add Display	N/D	10 00	
	Inche	11 Cm	
Order Goods	Bar Cole	1000	
Add Display Cancel	the second second	11 10	
Truck Details	Sne	No.	
Add Display		lessage 🔀	
Load Optimization		Socossila Aaber	
eveloped by B. NARENDRA BABU	L		

Figure. 5 Required package box parameters

This screen is used to add the parameter for every box such as length, breadth and height, code for box, maximum weight for that box based on item nature in which it is required for filling the load by calculating the total weight for the number of boxes and further it compares this total weight with total tonnage capacity of the selected vehicle as well as it compares the total length, breadth and height for all the boxes that is used to be fit with total length, breadth and height of the vehicle. It is also used to display the parameters for the existing parameter of box. Here it is consider that, all the box size are equal but item weight that is filled in box may vary in which total weight would be vary accordingly.



OverView		
Item Parameters Add Display	Welcome To Goods Order	
Package Box Parameters Add Display	the Cational Unit Cational	
Order Goods Add Display Cancel		
Truck Details Add Display		
Load Optimization		
Developed By B. NARENDRA BABU		
fister accorden +	🗧 kore Sen ik-H	814780742

LOGISTICS LOAD OPTIMIZATION

Item Parameters Ad Objeky Package Box Parameters Ad Objeky Order Goods Ad Objeky Gines Truck Details	
Aso begay terminany to begay terminany termina	
Package Box Parameters Ad Display Order Goods Add Display Cancel Truck Details	
Order Goods Add Display Concel Truck Details Md Details	
Truck Details	
Aug	
Load Optimization	
Developed by B. NARENDRA RABU	

Figure. 6 Order entry by each customer

E 10 🐰

This screen is used to open the order form for every customer for booking the item by clicking the submit button after generating the Booking_id automatically.

LOGISTICS LOAD OPTIMIZATION

Item Parameters Add Depart Add Depart Demark Order Goods Standarder Enternet Add Depart Standarder Truck Details Bestragter Cattor Add Depart Cattor Truck Details Bestragter Cattor Load Optimization Standarder Cattor	
Add Deplay Drive to the set of the	
Add Display Motions from tame Motions of Million Add Display Motions Motions of Million Order Goods Tot Million Motions of Million Add Display Cancel Motions of Million Truck Details Motions from Display Add Display Motions from Display Load Optimization Motions from Motions from	
Add Display In others Interface Content Conten	
Order Goods Indivent Implement Add Display Cancel Servar Nex CECNACO Add Display Cancel Devery Nex Servar Nex Truck Detailis Beving New Servar Nex Servar Nex Add Display Beving New Servar Nex Add Display Beving New Servar Nex Load Optimization Image Nex	
Creer Goods Seran Hara (ECEMAD) Add Display Cancel Delwyrflaw Sattop (Truck Detail)S Bewyrlaw Sattop (Add Display Bewlag inter Sattop (Add Display Bewlag inter Sattop (Load Optimization Sattop (Sattop (S	
Add Display Cancel Dewytiew Sattool Truck Details Devision 20.0000000 Add Display Boolegine Sattool Load Optimization	
Truck Details Beaugene 23.3.301 DOMENTY Add Display Beaugene 24.520 Houses Load Optimization	
Add Display Reserve Rest	
Load Optimization	
Load Optimization	
Zana Jonard Ser	
D VIDDINDI DIDI	

Figure. 7 Item ordering by each customer

This screen is used to enter the item required for the concern customer which includes the source and destination to which the items has to be sent, item name, number of boxes and total weight of that item, booking date for customizing the load fitting.

LOGISTICS LOAD OPTIMIZATION



LOGISTICS LOAD OPTIMIZATION



Figure. 8 Cancellation of booked order

This screen is used to cancel the items either partially(single item cancellation for multiple items ordered under same booking_id). Or completely(entire order).

LOGISTICS LOAD OPTIMIZATION

Item Parameters	ADD TRU	JCK PARA	METERS			
Add Display						
Dackana Ray Daramatara	Enter Truck type	11	· Retains			
Package Box Parameters	Pile of Tracks					
Add Display	Longth	330	CH			
Order Goods	Weath	11 80	Cm			
Add Display Cancel	Height	1 IC	Cm			
	Torecage	1100	Res			
Truck Details	Higgs capacity		Result			
Add Display	Save	. Think				
Load Optimization						
1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -) Secondal	Patient			
Developed By		10				
B. NARENDRA BABU						
Start Burgererreiten Burer	water Maria				81476780	893 .00

Figure. 9 Truck details

This screen is used to enter the parameter required for each type of vehicle or truck. It is required for fitting the load based on the ordered items on the specific booking date with respect to vehicle parameters such as tonnage capacity, length, breadth and height

LOGISTICS LOAD OPTIMIZATION

		12.00	1 TOULOT C	>00111	ing companie	10 J .
OverView Item Parameters	Ľ	DAD OP1	rimization			
Add Display Package Box Parameters Add Display	Enter	Doarrieg date	29060011	8 51771)		
Order Goods Add Display Cancel	BOX PARAM	ETERS	VEHICLE	Paramet	ERS	
Truck Details Add Display	Length of bev Width of bev	10 50	Cas Vehicle length Cas Vehicle width	230	On On	
Load Optimization	Helipht of box Total pands weight	53 998	Cas Vehicle beight Ngs. Vehicle brang	181 1013	Ces Rep	
Developed By B. NARENDRA BABU	Tatal Danes	Leon	(Perzess			
Start a cyacosaya.	Sown Brettin - Nr	. 0				8 7 8 9 6 4 8 0 6 4 2 1 0 1 1

Figure. 10 Booking date selection for load fitting

This screen is used to retrieve and display the box and vehicle parameters by entering the booking date. It retrieves the suitable vehicle from the available vehicle automatically by comparing the total number of boxes and total weight of the various items that is to be fitted in the vehicle for the selected booking date.

LOGISTICS LOAD OPTIMIZATION (For Manufacturing Companies) OverView LOAD OPTIMIZATION tem Parameters Add Dipplay Package Box Parameters Add Dipplay Order Goods Add Dipplay Cancel Truck Details Add Dipplay Load Optimization

B. NARENDRA BABU

. E 🗙

This screen is used to select the proposed implemented algorithm to find out the best suitable load fitting for the selected booking date and available number of boxes(optimization).

LOGISTICS	S LOAD (For	Manufa	LMIZATION cturing Companies)				
OverView	FINAL R	IPORT		1	2	3	
Item Parameters	BOXLENETH	æ	ta .				
Piece Picping	BOX WE'TH	60	Cm	5	8	1	1
ackage Box Parameters Add Disulay	ROXINGRI	52	Da				
	TOTAL GOODS WEREIT	% 3	Kas		11	11	8
Order Goods And Display Cancel	VEHICLE LENGTH	211	Ca.				-
nua anger varet	VEHICLEWIDTH	181	Cm	13	-14	15	- 16
Truck Details	VENDENEGAT	a.	Cm.				
	VEHICLE TOMMAGE	1000	Kas	g	18		
Load Optimization	TOTAL NO OF BOXES TO HTT	115					
	TOTAL NO OF BOXES RITIED	18					
Developed By	USED ALGORITHM	General Alg					
B. NARENDRA BABU							

Figure. 12 Load fitting - General Algorithm

This screen shows the Load fitting with general algorithm. The total numbers of boxes fitted through this algorithm are 18 boxes based on the input shown in Fig. 10

OverView	FINAL R	SPORT			2	3
Item Parameters	BOKLENGTH	BQ	Co	4	5	6
AUU DISUIAY	BOIK MIDTH	50	Cm			
ackage Box Parameters	RECEIPTION	50	Cm	1	8	5
	TOTAL GOODS WEIGHT	39	Rgs		11	Ø
Order Goods Add Display Cancel	VEHICLELEMETH	230	Cm			
	VEHICLE WORK	180	CH .	13	14	15
Truck Details	VEHICLE HEIGHT	196	Da	15	9	18
	VEHICLE TONNAGE	1000	Kp			
Load Optimization	TOTAL INC OF BOXES TO FIT	115				
	TOTAL NO OF BOMES FITTED	18				
Developed By	USED ALGORITHM	Lawing				
B. NARENDRA BABU						

Figure. 13 Load fitting - L & W Algorithm

This screen shows the Load fitting with L & W algorithm. The total number of boxes fitted through this algorithm are 18 boxes based on the input shown in Fig. 10.

OverView	FINAL RE	PORT		1	2	3	4	5
Item Parameters	BOKLENGTH	8	Ca					
	90KW0TH	1	Cm	.4	1	1	9	10
ackage Box Parameters	BOK HEIGHT	30	Ca					
	TOTAL GOODS WEIGHT	960	Ngs	-11	12	13	14	15
Order Goods	VEHICLE LENGTH	200	Ca.					
Muu Display Galicel	VEHICLE WIDTH	180	(m	16	17	11	19	20
Truck Details	VEHICLEHEIGHT	10	Ca	-		_		
Add Uispiay	VEHICLE TOWNAGE	1800	ha .	21	22	23	24	
Load Optimization	TOTAL NO OF BONES TO HIT	115						
	TOTAL NO OF BOMES FITTED	N						
Developed By	USED ALGORITHM	LEHAD		L				
Developed By	TOTAL NO OF BONES FITTED	2N L.6.H.Alg						

This screen shows the Load fitting with L & W algorithm. The total number of boxes fitted through this algorithm are 24 boxes based on the input shown in Fig. 10. This shows that, it accommodates more number of boxes than other two algorithms and it is consider as a best approach for the given input. But in some scenario, one among the 3 algorithms may be best according to the vehicle parameters and number of equal size boxes that is to be sent.



Figure. 15 Load fitting - Invalid entry of booking date

This screen shows the invalid entry of booking date i.e. if we try to retrieve the booking date which the booking order is not taken is consider as invalid date and retrieving such date shows the error message.

LOGISTICS LOAD OPTIMIZATION

VII. CONCLUSION

The Load Optimization is achieved in the form of maximum utilization of space for similar type of boxes by using one of the three proposed algorithms. By using these algorithms the wastage of space between boxes is minimized. Hence we believe that, this approach will be useful for manufacturer of multiple items which they would sent those items to ordered customers

VIII. FUTURE WORK

This approach work for single vehicle loading for similar type of boxes and one source & one destination only. The same approach can be enhanced with,

- a. Multiple vehicle loading problem
- b. One Source to Multiple Destination.
- c. Route optimization

IX. REFERENCES

- P. Davies and E. E. Bischoff., Weight distribution considerations in container loading. European Journal of Operational Research, 114:509–527, 1999.
- [2]. Andrew Lim, Xingwen Zhang, The Container Loading Problem, SAC'05, March13-7, 2005, SantaFe, New Mexico, USA
- [3]. E. E. Bischoff, F. Janetz, and M. S.W. Ratcliff., Loading pallets with non-identical items. European Journal of Operational Research, 84:681–692, 1995.
- [4]. G. Scheithauer and U. Sommerwei, Block heuristic for the rectangle packing problem, European Journal of Operational Research, 108:509–526, 1998
- [5]. J. A. George and D. F. Robinson., A heuristic for packing boxes into a container. Computer and Operations Research, 7:147–156, 1980.
- [6]. Nigeria Somuyiwa, Adebambo layinka, Analysis of Transportation Cost in Overall Logistics Cost Management of manufacturing Companies in Southwestern. Vol.44 No.3 (2010), pp.420-429
- [7]. Yung-yu TSENG, Wen Long YUE, The Role of Transportation in Logistics Chain, Proceedings of the Eastern Asia Society for Transportation Studies, Vol. 5, pp. 1657 -1672, 2005

- [8]. Weijian Huang, Hua Zahao, Liang Huang, Wei Dum, Management Information System Applied In the Logistics, 2010 International Conference on Intelligent Computation Technology and Automation, DOI 10.1109/ICICTA.2010.370, pp. 628 – 628
- [9]. Xusheng Xu, Haillong Ma, Application in logistics enterprises for knowledge management, 2010 International Conference on E-Business and E-Government, DOI 10.1109/ICEE.2010.840, pp. 3343-3346

AUTHOR'S PROFILE

J. Sheik Mohamed has obtained MCA Degree from Bharathidasan University in the year 2000, who is currently pursuing Ph.D(PT) Computer Science at S.V.University, Tirupathi, Andhra Pradesh. He has published 8 papers in international and national journals. He is working as an Asst. Professor in SITAMS, Chittoor, A.P. with the experience of 11 years. He is a life member of CSI and ISTE.

P. Narendra Babu has obtained MCA degree from JNTUA, Anantapur through MCA Department, SITAMS, Chittoor, A.P.

Dr. S. Sreekanth has obtained M.Sc. Degree from S.K. University, Anantapur and M.Phil., Ph.D., Degrees from S.V.University, Tirupathi and M.E.(CSE) from Sathyabama University, Chennai. Currently he is guiding 2 Ph.D. scholars in Computer Science at Rayalaseema University, Kurnool, Andhra Pradesh. He is working as a Professor & Director in MCA Department, SITAMS, Chittoor, Andhra Pradesh with the experience of 16 years. He has published 13 research papers both in international and national journals of mathematics and computer science

Dr.N.Ch.S.N. Iyengar(M.Sc,M.E,Ph.D.) is a Senior Professor in School of Computing Science and Engineering at VIT University, Vellore, Tamil Nadu, India. His research interests includes Agent based Distributed Computing, Data Privacy and Security, Cryptography, Intelligent computational methods and Bio informatics. He has authored several textbooks and had nearly 100 research Publications in International Journals. He chaired many international conferences and delivered invited/ technical lectures/ keynote addresses besides being International program committee member.