

# International Journal of Innovative Research in Science, Engineering and Technology

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## A Study on the Optimization of Resources by Linear Programming with System Approach

G.S.Grincy<sup>1</sup>, Prof. J. Shiny Mol<sup>2</sup>

PG Student, Dept. of Civil Engineering, Arunachala College of Engineering for Women, Nagercoil, Tamilnadu , India

Asst. Professor, Dept. of Civil Engineering, Arunachala College of Engineering for Women, Nagercoil,  
Tamilnadu , India

**ABSTRACT:** This paper demonstrates the use of linear programming methods as applicable in the construction company. Many construction companies are still established to derive financial profit. In this regard the main aim of such establishment is to maximize the profit. Linear programming shows that algorithm is very promising in practice on a wide variety of problems. This project is on using linear programming technique to derive the maximum profit from resource management of building construction. Nowadays, managers are evaluated by their decision-making. Construction companies need adequate resource optimization to improve the profitability and productivity of the organization. Linear programming is one of the strongest techniques which can be used by managers to solve problems considering subject to the settings of the problem. In this project, data be will be collected from the Public Work Department. Using Linear Programming Problems the data should be solved and the same data will be implemented in PRIMAVERA (P6). The results from the above two were compared and the optimal result can adopted. Thus the resource will be optimized and come to the conclusion of project

**KEYWORDS:** Linear programming, Resource optimization, financial profit, PRIMAVERA (P6)

### I. INTRODUCTION

One of the guideposts of economic thinking is the idea that agents (individuals, firms, etc.) are self-interested and always economizing. In other words, they will try to reach the maximum level of utility at the minimum cost. For starters, why do (most) firms exist and it is not because the owners want to produce a good for other people out of the goodness of their hearts, but because they want to make money. Even more, they do not just want to make money, but they want to make as much money as possible ( or) in other words, maximize their profits.

This process of maximizing or minimizing is known as optimization, or mathematical programming. Its job is to find the solution (product mix, allocation of resources, investments, etc.) that leads the best result - the highest profit, or output, or return, or the one that achieves the lowest cost, or waste.

These optimization problems can be linear or nonlinear, depending on the mathematical form of the various functions included in the model. They can be constrained or unconstrained. They can be solved graphically (although they might be exponentially more difficult to solve graphically if the model is nonlinear, or if it contains a large number of variables), or through the use of statistical software. Additionally, linear programming provides an excellent opportunity to introduce the idea of "what-if" analysis, due to the powerful tools for post-optimality analysis developed for the linear programming model.

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## II. LINEAR PROGRAMMING

Linear Programming (LP) is a mathematical technique and determining optimal allocation of limited resources to meet given objectives. The resources in the form of manpower, raw material, money and machines etc.. Linear programming is a mathematical technique for maximizing or minimizing a linear function of several variables, such as output or cost.

### Different Linear Programming Problem (LPP)

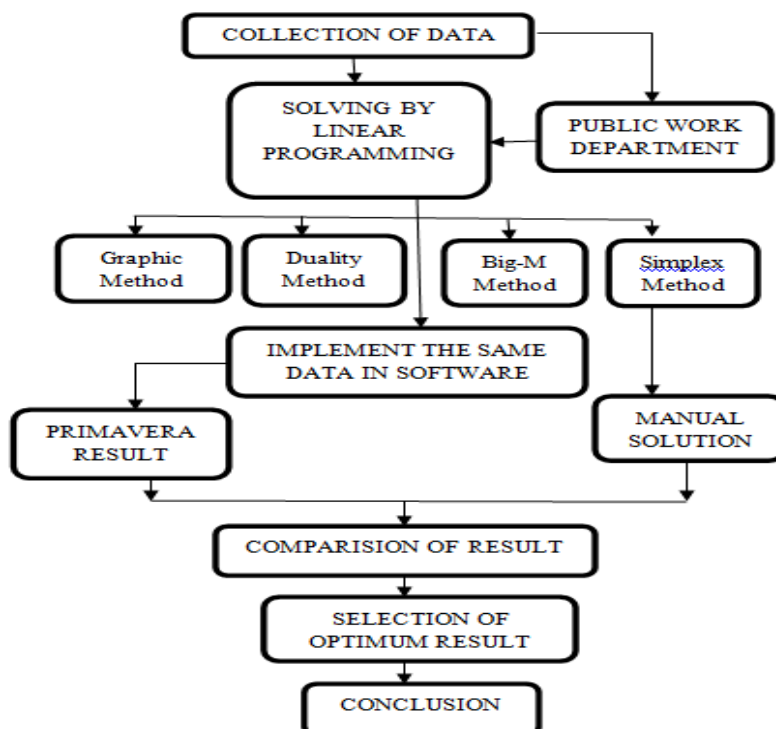
To find the solution to a linear programming model, we have the following methods,

- i. Graphical method
- ii. Algebraic method or Simplex Method
- iii. Duality problem
- iv. Big-M Metho

## III. LITERATURE REVIEW

The study about OPTIMIZATION OF RESOURCES BY LINEAR PROGRAMMING AND SYSTEM APPROACH method were carried out by referring various literatures. The paper "LINEAR PROGRAMMING AND OPTIMIZING THE RESOURCES" gives more ideas about optimization of resources, and also states that the managers are trying to maximize their profit on one hand and minimizing their costs on other hand. The linear programming model is used by the managers to determine the most economical arrangement of finance to arrange the best times to start and finish projects. This paper gives deep idea about linear programming method. The resources in the form of manpower, raw material, money and machines etc. The linear programming problem can be solved in computer by using software PRIMAVERA.

## IV. METHODOLOGY



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### IMPLEMENT THE DATA WITH SYSTEM APPROACH

In this linear programming problem can be solved in computer program by using different software. The software's are PRIMAVERA, MATLAB, LINDO, and AMPL etc. In this project PRIMAVERA is used

### DATA COLLECTION

The following data was describing the raw material needed for school building brick construction. The building has ground plus two storey's and the area of the building was 9000 sq ft. The estimate day for complete the brick structure was 90days. The building estimated cost is Rs.16200000.

Quantity of resource available for brick structure

RAW MATERIAL NEED FOR BRICK STRUCTURE	QUANTITY AVAILABLE FOR STRUCTURE
Manpower (no's)	11550
Cement (50 Kg bag)	4500
Sand (cft)	23400
Brick (no's)	49950

Quantity of resource required for each floor

Floor Resources	Ground Floor (per day)	First Floor (per day)	Second Floor (per day)
Manpower (no's)	45	43	41
Cement (50 Kg bag)	20	18	13
Sand (cft)	89	86	86
Brick (no's) (each floor)	16650	16700	16600

Average Profit for 3 Floors

FLOOR	PROFIT(Rs)
Ground Floor	567000
First Floor	729000
Second Floor	567000

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### THEORETICAL EVALUATION

$$\begin{aligned} \text{Max } Z &= 567000X_1 + 729000X_2 + 567000X_3 \\ \text{Subjected to } &45X_1 + 43X_2 + 41X_3 \leq 11550 \\ &20X_1 + 18X_2 + 13X_3 \leq 4500 \\ &89X_1 + 86X_2 + 86X_3 \leq 23400 \\ &16650X_1 + 16700X_2 + 16600X_3 \leq 49950 \end{aligned}$$

Since all  $Z_j - C_j \geq 0$ , the current basic feasible solution is optimal.

The optimum Solution is  $X_1=0, X_2=21.363, X_3=0$

$$\begin{aligned} \text{Max } Z &= 567000X_1 + 729000X_2 + 567000X_3 \\ &= 0 + 729000 * 21.363 + 0 \\ &= 15574200 \end{aligned}$$

$$\begin{aligned} \text{Maximum profit} &= \text{total cost} - \text{Max } Z \\ &= 162000000 - 15574200 \\ &= 625800 \end{aligned}$$

ID	Activity description	Duration	predecessor
1	Earthwork excavation for foundation	5	-
2	Earthwork open excavation for septic tank	3	1
3	Cement concrete mix 1:5:10	15	1
4	Random Rubble Masonry in cement mortar 1:5	5	2,3
5	Refilling the basement with excavated earth	2	4
6	Supplying and filling in foundation and basement with stone dust	4	5
7	Rough stone dry packing filling using stones	2	5
8	Damp proof course in cement mortar 1:4	8	5
9	Supplying and erecting shuttering	10	6,7,8
10	Supplying and erecting water tight steel	3	9
11	Cement Concrete mix 1:1.5:3	3	9
12	Supplying, fabricating and placing in position of mild steel	7	9
13	Brick partition walls using country bricks	35	10
14	Precast reinforced cement concrete slab	10	13
15	Weathering course concrete using broken brick	15	14
16	Ceiling plastering and finishing all the exposed RCC surfaces	20	15
17	Plastering with cement mortar 1:5	10	16
18	Providing black board in two layers of cement mortar 1:3	5	16
19	Pre-construction anti-termite treatment plinth area	2	17
20	Paving the floor with Rajasthan kota stone	5	11,12,19
21	Paving the floor with eurocon tiles	10	18,20

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22	Supplying and fixing cupboard shutter	3	21
23	Manufacturing supplying and fixing of steel doors	10	22
24	Manufacturing supplying and fixing of steel doors	9	23
25	Supplying and fixing of mild steel window	5	24
26	Manufacturing supplying and fixing in position steel sheeted windows	10	23,24
27	Supplying and fixing iron grills for windows, ventilators	4	26
28	Supplying and fixing steel balustrades	3	27
29	Supplying and fixing G.I.pipe hand rails	5	27
30	Providing reinforced cement concrete jally	20	27
31	White washing three coat	7	28,29,30
32	Distempering two coats	5	31
33	Painting the walls with two coats	5	31
34	Supplying and painting new iron work	3	31
35	Drilling of bore well	2	32
36	Supply of PVC plain casing pipes	2	35
37	Supplying, laying and joining P.V.C. pipes	2	36
38	Supplying and fixing of PVC water tank	3	37
39	Total value of electrical work	2	38
40	Provision for Rain water Harvesting	2	39
41	Provision for labour welfare fund 1%	2	39
42	Provision for foundation stone laying	2	40
43	Provision for advertisement charges	2	38,39,42
44	Provision for Geophysical survey	2	41,43
45	Provision for Documentation charges	2	44
46	Provision for Photographic charges	2	45
47	Provision for Name board arrangement	5	46
48	Provision for Front elevation	5	46,47
49	Provision for petty supervision charges	5	48
50	Finishing work	0	49

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## OPTIMIZATION RESULT IN PRIMAVERA

Optimization of Resources					
17-Apr-17 14:48					
<b>Optimization</b>					
Activity ID	Activity Name	Budgeted Total Cost	Budgeted Nonlabour Cost	Budgeted Material Cost	Budgeted Labour Cost
A 1000	SOP	Rs. 0	Rs. 0	Rs. 0	Rs. 0
A 1010	Ground Clearing	Rs. 482	Rs. 0	Rs. 0	Rs. 482
A 1020	Earth Work Excavation	Rs. 22420	Rs. 17600	Rs. 0	Rs.4820
A 1030	PCC 1:4:8	Rs. 221584	Rs. 0	Rs. 209264	Rs. 12320
A 1040	1st Footing	Rs. 335089	Rs. 0	Rs.317169	Rs. 17920
A 1050	2nd Footing	Rs. 335089	Rs. 0	Rs. 317169	Rs. 17920
A 1060	Column Concrete	Rs. 4820	Rs. 0	Rs. 0	Rs. 4820
A 1070	Sand Filling	Rs. 4820	Rs. 0	Rs. 0	Rs. 4820
A 1080	RR Masonry	Rs. 335089	Rs. 0	Rs. 317169	Rs. 17920
A 1090	Plinth Beam Concrete	Rs. 35840	Rs. 0	Rs. 0	Rs. 35840
A 1100	Column Centering	Rs. 324046	Rs. 9900	Rs. 297346	Rs. 16800
A 1110	Beam & Slab Concrete	Rs. 314146	Rs. 0	Rs.297346	Rs. 16800
A 1120	Lintel & Shade	Rs. 423400	Rs. 0	Rs. 417800	Rs. 5600
A 1130	Solid Block Construction	Rs. 188960	Rs. 0	Rs. 177760	Rs. 11200
A 1140	Roof Slab Bottom Plastering	Rs. 113376	Rs. 0	Rs. 106656	Rs. 6720
A 1150	Roof Slab Top Plastering	Rs. 377920	Rs. 0	Rs. 355520	Rs. 22400
A 1160	Wall Plastering	Rs. 188960	Rs. 0	Rs. 177760	Rs. 11200
A 1170	Laying Ceramic Glazed Floor Tiles	Rs. 2660	Rs. 0	Rs. 0	Rs. 2660
A 1180	White Washing	Rs. 2660	Rs. 0	Rs. 0	Rs. 2660
A 1190	Wall painting with emulsion	Rs. 2128	Rs. 0	Rs. 0	Rs. 2128
A 1200	Wall painting with enamel paint	Rs. 5600	Rs. 0	Rs. 0	Rs. 5600
A 1210	Fixing doors & windows	Rs. 293010	Rs. 0	Rs. 266640	Rs. 26370
A 1220	Water supply & sanitary arrangements	Rs. 454061	Rs. 35200	Rs. 396461	Rs. 22400
A 1230	Construction of septic tank	Rs. 11200	Rs. 0	Rs. 0	Rs. 11200

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## OPTIMIZED TOTAL BUDGETED COST

Optimization of Resources					
17-Apr-17 14:48					
<b>Optimization</b>					
Activity ID	Activity Name	Budgeted Total Cost	Budgeted Nonlabour Cost	Budgeted Material Cost	Budgeted Labour Cost
<b>Total</b>		Rs. 1538672	Rs.62700	Rs. 4066347	Rs. 299300

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## V. RESULT AND DISCUSSION

### RESULTS OBTAINED BY LINEAR PROGRAMMING.

The following results are obtained in Linear Programming. This helps in optimization of resources and thereby minimizing the cost of construction and hence maximizes the profit. The total estimated cost of construction is Rs.16200000/-. By using Linear Programming Method, it is proved that a profit of Rs.625800/- can be achieved. And this is why in most of the companies they use simplex method for optimizing the resources.

### RESULTS OBTAINED BY SYSTEM APPROACH

Owing to the crisis which was identified as a result of scheduling the project, Resource Balancing was adopted to be applied to the project, so that there is better control on the project cost and project duration by resolving the resource conflicts. As an initial attempt to establish control over the project cost from not reaching a drastically higher value, Resource Smoothing was performed. The Resource Smoothing technique, after being applied to the project, yielded with a reduction in the total project cost by Rs.15,38,672/- which is about 11.02% of the projected project cost. Hence, from the results of Resource smoothing, it was understood that optimizing of the way the resources constituting the project are handled, would pave way for a reduction of the total project cost.

### COMPARING BOTH RESULTS

By comparing both the result it is clear that the result obtained by the system approach (Primavera,P6) gives the most optimum value because it gives the maximum profit than the result we obtained by Linear Programming Problem (Simplex Method). Thus the system approach is more suitable in maximizing the profit in construction by optimizing the resource.

## VI. CONCLUSION

In this project, the required data is collected from the Construction works done by the Public Work Department. The collected data is solved using Simplex Method in Linear Programming and also with the System Approach. Thus by solving theoretically & analytically the optimum resource for the construction is evaluated. Then comparing the solutions from both simplex as well as primavera, I came to the conclusion about which one will give the optimum resource to maximize the profit and minimize the cost by optimizing the resource. As by this comparison, it is clear that the result I got by the system approach gives a profit of Rs.15,38,672/- leads to the most optimal resource in which it maximizes the profit & minimizes the cost.

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