European Journal of Business and Management
ISSN 2222-1905 (Paper) ISSN 2222-2839 (Online)
Vol.6, No.20, 2014

To Explore and Exploit the Available Human Resources to an Optimum Level in the Industrial Sector of Khyber Pakhtunkhwa, Pakistan

Hamid Rauf[1], Khair uz Zaman[2], Farhatullah Khan[1], Irfanullah Khan[3]
1.Department of Business Administration, Gomal University, Dera Ismail Khan, Pakistan
2.Director, Institute of Information Technology, COMSATS Vehari, Pakistan
3.Department of Public Administration, Gomal University, Dera Ismail Khan, Pakistan

Abstract
The divine, since the inception of this universe, has awarded too many natural and human resources yet to be explored. It is the liability of the human kind to dig out these natural secrets which are beneficial for the mankind and for the sustainable development as well. In this regard, the appropriate knowledge is the key to pursue the phenomenon. The most supreme and wise creation of the God is human kind to whom He has awarded a great sort of potentials. The human being possesses such type of processing unit, named as brain, through which he/she can manifest extra ordinary type of intelligence. This very quality make the human being distinguished among the all other creations. Furthermore, it is the knowledge alone which can impart super intelligence to the mankind by which he/she can revolutionize any sector of economy. In this research an effort has been made to provide a frame work, which in turn, leads to optimal utilize the manpower resource. Now the question arises how to figure out the existing human resources, to impart appropriate knowledge to them and last but not the least to utilize them to their best utility and credibility. The aim of this study is to search out techniques to utilize the manpower resources in a best possible way with special reference to Lucky Cement Ltd and how it can be generalized.
Keywords: Human Resources, Optimization, Industrial Sector (Lucky Cement), Pakistan

1. INTRODUCTION

In every sector of economy, especially in the developing countries, some very drastic measures are direly needed those which can elevate the functioning and output level. This phenomenon is only feasible through a strong vision, farsightedness and long term planning based upon the modern theories of development. The first prerequisite, in this regard, is to manipulate the existing human resources though the figure is very small as for as the skill and the experience is concerned. On the other hand, the financial resources are also too little to achieve the desired goals as per the global standards. Moreover, the present market status which is marked with the chronic slump and other negativities, it is a herculean job to introduce a product with meagre resources. In this scenario, the process of optimization is the only way out to overcome the prevailing socio-economic and managerial restrictions.

The Lucky cement factory (Ltd), in capacity and production, is among the largest industrial unit in the province of Khyber Pakhtunkhwa, Pakistan. Lucky cement is Pakistan's first and largest exporter of loose cement. This production unit does not cater at the national level rather it has a loading point at the Karachi port for the export purposes as well. The Lucky cement factory also provide its own logistic exclusively. The company is registered and listed on Karachi, Lahore and Islamabad as well as in London Stock Exchanges. Over the years, the company has grown substantially and is expanding its business operations with production facilities at strategic locations in Karachi to Qatar to the southern region Pezu, KPK to furnish the northern areas of the country. Lucky cement limited is an ISO 9001: 2008 & 14001:2004 certified company and also possesses many other international certifications and accreditations as well. Lucky Cement comprehend our core values regarding human and natural resources. Thus, these values are not only on paper and pen but lounge deep in the heart of each individual working or associated with lucky cement. Lucky Cement Limited is managed by the team of professionals, who are committed and dedicated to fulfill the mission and vision of the organization. Two production plants and five marketing offices are managed by the staff strength of then 1800 permanent employees throughout Pakistan.

During the year under review, the Company is increasing their production capacity and their performance as in 2006-07 the clinker production was 4512876 tons while in 2007-08 there was increased up to 5161380 tons, the total increase in clinker production was 17.37%, similarly the cement production, Cement dispatches and clinker dispatches were also increased to 18.68%, 20.64% and 5.25% respectively. A comparison of the key financial results of the Company for the year ended June 30, 2008 with the same period last year. The table shows increasing trend in their sales and profit.

	2008	2007	%
Sales	16,958	12,522	35.42%
Gross Profit	4,363	3,675	18.71%
Net Profit after tax	2,678	2,547	5.13%
Earnings Per share	9.84	9.67	1.76%

1.2 Statement of Problem

This research work is concerned with adaptation of Optimization Techniques to utilize the manpower resources in a best possible way in cement industries with reference to Lucky Cement Ltd, Pezu, Pakistan. In this research an attempt has been made to develop a framework, how to utilize the manpower resources optimally in industrial sector, especially in cement industries.

1.3 Main Hypothesis

By using linear programing model, to minimize the Labor cost through optimization technique.

1.4 Justification of study

Maintenance time analysis (Sodiki, 2001), Dynamic programming (Aderoba, 2000), Multiple Activities Process Chart (Lindley, 1988), Queuing System (Kareem and Aderoba, 2000, 2004; Taha, 1987; Rao and Rao, 1993; Shaw, 1976; Aust, 1976; Angel, 1986; Axsater, 1987; Ibaraki, 1978; Fite,1953). In the above models, equal ability of manpower was assumed under infinite production capacity and time of operation at minimum possible cost. This study utilizes linear programming model to minimize labor cost in multiple shifts with respect to production and maintenance. The main object of man power planning in an organization is to minimize cost or maximize profit subject to available Production / demand capacity and time of operation. (Akinyele & Taiwo.S, 2007).

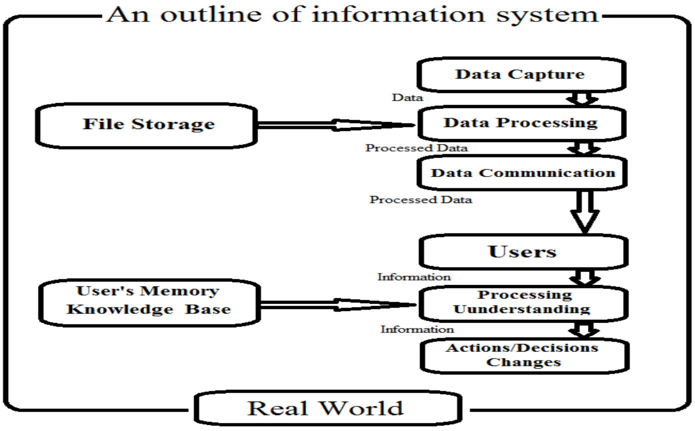
2. LITERATURE REVIEW

Among all the inputs to any system i.e. Management, Money, Material, Men, Machinery, Mansion, Message etc. the most important one is the Man who is responsible to operate and activate these resources economically, efficiently and effectively to achieve maximum utility. That is why when managerial staff makes rational decisions; right information at the right time and in right form is required to them. Hence research is required to find out ways and means of optimum utilization of the manpower resource in the industrial sector in general and in cement industries in particular. Many quantitative techniques have been used to determine effective size of competent manpower to engage at a particular time. Among these are: Workload method (Omolayole, 1996; Banjoko, 1996; Folayan, 1998; Fajana, 2002; Fapetu and Kareem, 2003).

Manpower planning is truly an interdisciplinary activity rooted in such diverse fields as economics, psychology, law and public administration, industrial relations, computer science, and operations research. National manpower planning is the integral portion of macro-economic planning which attempts to achieve maximum utilization of human resources in terms of societal goals **(**George., 1976**)**. The closest reference to the expression "optimal utilization of resources" is "value-for-money". According to this universally-recognized concept, all business processes are characterized by the use of a group of inputs (resources), which are transformed (activities) into outputs (results). The optimization of resources is based on three characteristics: economy, effectiveness and efficiency.

Strategic human resource management (SHRM) focuses on aligning internally consistent human resource management (HRM) practices to build employees' knowledge, skills, and abilities in an effort to support competitive strategies and achieve business objectives. SHRM is gaining increasing importance because strategic management, in a knowledge-based economy, emphasizes that employees are considered to be a primary component for attaining a competitive advantage. SHRM is gaining increasing importance because strategic management, in a knowledge-based economy, emphasizes that employees are considered to be a primary component for attaining a competitive advantage HRM practices create procedures that institutionalize the building of employees' knowledge, skills, and abilities throughout the organization to promote valued, unique, and difficult to imitate organizational competencies which support competitive advantage (Werbel., 2005).

Project scheduling techniques under human resource constraints are referenced with the objective of minimizing project duration, and a proper human resource allocation algorithm standing on multi-project scheduling, with a heuristic procedure for searching out approximate optimal allocation, is adopted. A forward/backward scheduling technique is the primary allocation algorithm; it evaluates maximal and minimal labor power allocations for activities (Cheng et al., 2006). Analysts develop strategy for allocating limited manpower resources based on command priorities, historical utilization data, and analysis of mission and functions. Analysts should have thorough knowledge of the Planning, Programming, Budgeting and Execution System (PPBES) documents or systems, the Structure and Manpower Allocation System (SAMAS), command plan, and TAADS for use in distributing and tracking approved allocations by budget program and organization Acpol.army (2009).



3. RESEARCH METHODOLOGY

3.1 Models

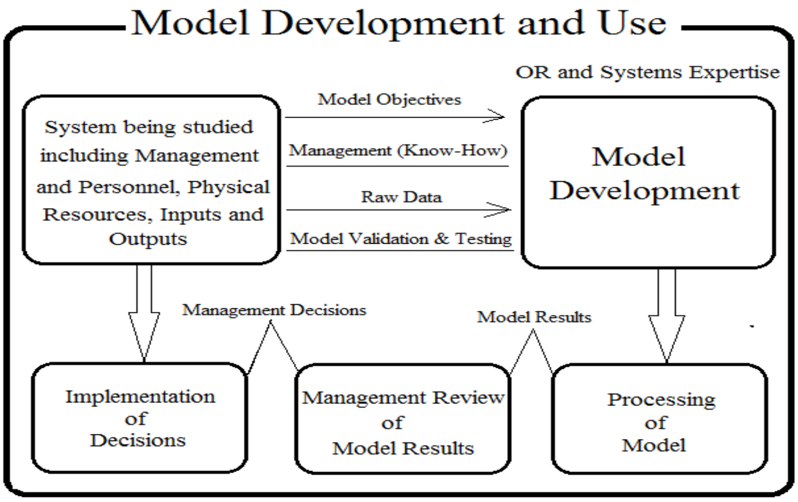
There are different models that are used for planning and decision making. T. Lucey, (2009) defined the model in simple words "Model is any simplified abstract of reality". It may be physical object such as architectural scale model or it may be what is termed as 'symbolic model'. These are representation of reality in numeric, algebraic, symbolic or graphical form. Business model are symbolic models which represent the organization operations by set of logically linked arithmetic & algebraic statements. These models are used to enhance a manager analytical ability.

3.2 Model Development

According to T. Lucey "To develop a model which is realistic and has adequate predictive qualities is a collaborative effort between management and information specialists (Lucey, 1991-1992).

The Key points are:

1. The model should have a purpose and be objective oriented.
2. Model building is an iterative, creative process with the aim of identifying those variable and relationships which must be included in the model so that it is capable of predicting overall system performance. It is not essential or indeed possible, to including all variables in a model. The variables in a model of greatest importance are those which govern, to a greater or less extent, the achievement of the specified objectives. These are the critical variables.
3. The best model is the simplest one with the fewest variables that has adequate predictive qualities. To obtain this ideal there must be a thorough understanding of the system. The management who operate the system have this understanding and must be involved in the model building, otherwise overelaborate and overly mathematical models may result if the model building exercise is left to systems professionals."



3.3 Optimization

James. O' Brien defined optimization as "It is a process of finding optimum value for one or more target variables, given certain constraints. Then one or more other variables are changed repeatedly, subject to the specified constraints, until the best value for the target variable are discovered" (O' Brien.1976). The most efficient technique which can handle a large number of variables and constraints is linear programming (LP) (Dantzig, 1963)**.** While it might seem to the uninitiated reader the LP models currently dominate the field, this is not necessarily the case. In many instances, aggregated simulation models precede more complex work. Another approach is "entity" simulation modeling in which individual records are stochastically "aged" during a simulated time horizon (Piskor, 1976).

3.4 Reasons for Using Models

T. Lucey summarized the reasons into three main categories (Lucey, 1991-1992);

- The model is cheaper
- Study and redesign
- Specialized assistance

3.5 Data Collection

Secondary data has been collected from different departments of Lucky Cement Limited, Pezu, KPK, i.e. Maintenance of the plant related data were collected from Stores, Mechanical & electrical department. Production related data were collected from production department, while the shift wise attendance and time sheets were collected from time office and admin department. Cost reports were collected from Accounts & Finance department.

4. DATA ANALYSIS

(Sekaran, 1998) Data Analysis has three objectives: getting feel for Data, testing the goodness of Data and testing the Hypothesis developed for the research. The feel for the data will give preliminary ideas of how good the scales are, how well the coding & entering of data have been done, and so on. The second objective ---testing the goodness of data ---can be accomplished by submitting the data for factor analysis & so on. The third objective ---Hypotheses testing--- is achieved by choosing the appropriate menus of the software programs, to test each of hypotheses using the relevant statistical test. The results of these tests will determine whether or not the hypotheses are substantiated. Secondary data is collected from lucky cement limited from Production Department as well as from maintenance i.e. mechanical & electrical department.

4.1 Modelling and Optimization

(Akinyele & Taiwo.S, 2007) used LP model with two variables i.e. Low performance manpower and high performance manpower in order to maximize profit using variables X1 and X2, the size Category A employees and Category B employees respectively.

$$\text{Max. P} = (r1C1)X\mathbf{1} + (r2C2)X2$$

Subject to:

$$A1X1 + a2X2b1$$
$$D1X1 + d2X2qi$$
$$X1, X1, 0 \text{ and integer}$$

The steps of solving the above formulated LP model come in following sequence:

- Solve the LP model using simplex or graphical method.
  - If the values of $x1$ and $x2$ are whole numbers.
  - Seat the bound for objective function: upper bound for maximization problem
  - Create sub-problems and fathom subset that yields inferior objective function value.
  - Partition / branch again selected unfathomed subset into sub-problems.
  - If all nodes have been satisfied, then 8 else 3.
  - Stop.

4.2 Standard LP Model Using Simplex Method

The use of basic solutions to solve the general LP model requires putting problem in a slandered form, whose properties are

1. All the constraints (with the exception of non-negativity restrictions on the variable) are equations with non-negative right hand side.
2. All the variables are not non-negative.
3. All the objective function may be of the maximization or the minimization type.

4.2.1 Conversion of in-equalities in to equations.

An in-equality of the type $\leq$ is converted to an equation by augmenting its left hand side with a slack variable

$$A\,X1 + B\,X2 + C\,X3 + S1 = Tp$$
$$a\,X1 + b\,X2 + c\,X3 + S2 = Tm$$

Whereas S1 and S2 ≥ 0

4.2.2 Conversion of un-restricted variable into non-negative variables

As all the variables are non-negative in the our study

4.2.3 Conversion of maximization to minimization

The maximization of a function f(X1,X2,……….Xn) is equivalent to the minimization of – f(X1,X2,……….Xn), in the sense that both problem yield the same optimal values of X1,X2……. and Xn.

The above problem is expressed in standardized form as

Minimize Z = C1X1 + C2X2 +C3X3 + S1 + S2

Subject to

A X1 + B X2 + C X3 + S1 = Tp (Production)

a X1 + b X2 + c X3 + S2 = Tm (Maintenance)

X1, X2, X3, S1 and S2 $\geq$ 0

5. RESULTS AND DISCUSSIONS

In order to evaluate the model, data for one month & three months were taken into account, the analysis performed on monthly bases was not sufficient in order to give proper results. Therefore three months data has been utilized to analyze the model. As there are three shifts namely Shift A, Shift B & Shift C, therefore predictor data of six basic predictors were utilized to construct initial Linear programming model. These basic predictors were used to construct the basic LP Model and these were grouped into two major categories i.e. Cost & maintenance. Cost was further divided as practically used in industry into its three sub component (Appendix - A). Similarly the total maintenance was also decomposed into four components related to maintenance.

The data was collected on the basis of one month then converted into three months production, three months maintenance and shift wise labor cost. Production and maintenance were corresponding ratio of their capacity limit. The calculated productions of all four quarters for the year 2007-08 have been presented in (Appendix – A). The resultant expression of basic LP model shows 5-10 % variations as observed in actual production and maintenance.

Evaluation of Quarter from July to September:

Minimize Z = C1X1 + C2X2 +C3X3 + S1 + S2

Subject to

A X1 + B X2 + C X3 + S1 = Tp (Production)

a X1 + b X2 + c X3 + S2 = Tm (Maintenance)

X1, X2, X3, S1 and S2 $\geq$ 0

Min Z = 19935938.5 X1 + 11689454.22 X2 + 2691204.405 X3 = 0

Subject to

14432830.35 X1 + 6770161.718 X2 + 2059658.346 X3 + S1= 378000

0.0000778249 X1 + 0.0000183893 X2 + 0.0000009408 X3 + S2 = 9246492993

X1, X2, X3, S1 and S2 $\geq$ 0

Basic Variable	Z	x1	x2	x3	s1	s2	solution	Ratio	
Z	1	19935938.5	11689454.22	2691204.405	0	0	0	0	
S1	0	14432830.35	6770161.718	2059658.346	1	0	378000	0.026190289	Pivot row
S2	0	0.00007782489	0.00001838929	0.00000094082	0	1	9246492993	118811513445193.00	

Pivot Column

The computation of new basic solution is based on the Gauss-Jordan Row operation. In the above mentioned table Pivot row is selected on the basis of lowest positive ratio, thus S1 is the leaving variable replacing S1 with entering variable X1 produces new basic solution.

While Pivot column is selected by taking maximum Positive value in column. The intersection of Pivot column and Pivot row define Pivot element. The Gauss-Jordan computation needed to produce new basic solution includes two types.

Type 1 : Pivot row
New Pivot row = Current Pivot row ÷ Pivot element
Type 2 : All other rows, including Z
New row = (Current row) – (its Pivot column Co-efficient) x (New Pivot row)
New Pivot row (NPR)

Type 1[st]

NPR	0	1	0.469080669	0.142706475	0.0000001	0.000000	0.026190289

Type 2 computation:

1. Z Row

Current Z Row:	1	19935938.5	11689454.22	2691204.405	0	0	0
-19935938.5 x NPR	0	-19935938.5	-9351563.375	-2844987.514	-1.381290989	0	-522127.9939

New Z row	1	0	2337891	-153783	-1	0	-522128

Basic Var	Z	x1	x2	x3	s1	s2	Solution	ratio
Z	1	-0.0000000373	2337890.844	-153783.1089	-1.381290989	0	-522127.9939	-0.223332922
x1	0	1	0.469080669	0.142706475	0.0000000693	0	0.026190289	0.055833231
s2	0	0	-0.00001811686	-0.00001016530	-0.00000000001	1	9246492993	-51038058458296
NPR	0	2.131829482	1	0.304225871	0.0000001	0	0.055833231	
Old Z Row	1	-0.000000037	2337890.844	-153783.1089	-1.381290989	0	-522127.9939	1
-2337890.844	0	-4983984.626	-2337890.8438124	-711246.878565	-0.345322747	0	-130531.9984691	-2337890.844
New Z row	1	-4983985	0	-865030	-2	0	-652660	

Final Table:

Basic Var	Z	x1	x2	x3	s1	s2	Solution
Z	1	-4983984.6257821100	0	-865029.9874	-1.726613736	0	-652659.9923
x2	0	2.131829482	1	0.304225871	0.0000001477	0	0.055833231
s2	0	0.0000386220537	0	-0.0000046536820	-0.0000000000027	1	9246492993

The steps for simplex methods defined by Taha.A.H (1998) are
Step 0: determining the starting basic feasible solution
Step 1: Select an entering variable using the optimality condition. Stop, if there is no entering variable.
Step 2: Select a leaving variable using feasibility condition
Step 3: Determine the new basic solution by using the appropriate Gauss-Jordan computations. Go to step 1.

Results

The results of the model shows that with the ratio of 0.055833231 decreases in shift B for the labor cost will result in optimum production as depicted in the result of the quarter. Only shift B has been obtained as basic variable from the model for which the total labor involved for this quarter was 220 persons (average) with the ration 0.055833231 decrease in the said number of personnel's result in the reduction of 12.28331072 Persons (12 Persons) which will have impact of Rs. 652,659.99 in the overall cost of production for shift B without affecting the total production. In other words the same labor should have to increase production for shift B with a ratio of 0.055833231.

The shift A and shift C variable have not been obtained basic variable but the nature of application is exactly same, therefore the same results can also be applied on shift A and C respectively.

Total impact per day shown in the below table

Shifts	Current Labor	Reduction	Proposed	Cost Impact
B	220	12.28331072	207.7166893	652,659.99
A	250	13.95830764	236.0416924	741,659.08
C	195	10.88747996	184.11252	578,494.08
Daily	**665**	**37.12909831**	**627.8709017**	**1,972,813.16**

These result shows that Daily 37 persons are working surplus having the cost impact of Rs.1, 972,813.16 per day.

Evaluation of Quarter from October to December:

Minimize Z = C1X1 + C2X2 +C3X3 + S1 + S2

Subject to

A X1 + B X2 + C X3 + S1 = Tp (Production)

a X1 + b X2 + c X3 + S2 = Tm (Maintenance)

X1, X2, X3, S1 and S2 $\geq$ 0

Min Z = 22500935.02 X1 + 10866599.8 X2 + 2912793.74 X3 = 0

Subject to

14546104.46 X1 + 7683478.415 X2 + 1941868.562 X3 + S1= 378000

0.00005396541 X1 + 0.00000893382 X2 + 0.00000060876 X3 + S2 = 9246492993

X1, X2, X3, S1 and S2 $\geq$ 0

Put the values in the table

Basic Var.	Z	x1	x2	x3	s1	s2	Solution	Ratio	
Z	1	22500935.02	10866599.8	2912793.74	0	0	0	0	
S1	0	14546104.46	7683478.415	1941868.562	1	0	378000	0.025986339	Pivot row
S2	0	0.00005396541	0.00000893382	0.00000060876	0	1	9246492993	171341099291717	

Pivot Column

The computation of new basic solution is based on the Gauss-Jordan Row operation. In the above mentioned table Pivot row is selected on the basis of lowest positive ratio, thus S1 is the leaving variable replacing S1 with entering variable X1 produces new basic solution.

While Pivot column is selected by taking maximum Positive value in column. The intersection of Pivot column and Pivot row define Pivot element. The Gauss-Jordan computation needed to produce new basic solution includes two types.

Type 1: Pivot row

New Pivot row = Current Pivot row $\div$ Pivot element

Type 2: All other rows, including Z

New row = (Current row) – (Its Pivot column Co-efficient) x (New Pivot row)

New Pivot row (NPR)

Type 1st

NPR	0	1	0.528215539	0.133497499	0.0000001	0.000000	0.025986339

Type 2 computation:

1. Z Row

Current Z Row:						
1	22500935.02	10866599.8	2912793.74	0	0	0

-22500935.02	0	-22500935.02	-11885343.53	-3003818.544	-1.546870166	0	-584716.9228

New Z row	1	0	-1018744	-91025	-2	0	-584717

Basic Var	Z	X1	X2	X3	S1	S2	Solution
Z	1	0	-1018743.731	-91024.80437	-1.546870166	0	-584716.9228
X1	0	1	0.528215539	0.133497499	6.87469E-08	0	0.025986339
S2	0	0	-0.000019572	-0.000006595	-0.000000000003710	1	9246492993

The steps for simplex methods defined by Taha.A.H (1998) are

Step 0: determining the starting basic feasible solution

Step 1: Select an entering variable using the optimality condition. Stop, if there is no entering variable.

Step 2: Select a leaving variable using feasibility condition

Step 3: Determine the new basic solution by using the appropriate Gauss-Jordan computations. Go to step 1.

Results

The results of the model shows that with the ratio of 0.025986339 decreases in shift A for the labor cost will result in optimum production as depicted in the result of the quarter. Only shift A has been obtained as basic variable from the model for which the total labor involved for this quarter was 250 persons (average) with the ration 0.025986339 decrease in the said number of personnel's result in the reduction of 6.496584721Persons (7 Persons) which will have impact of Rs. 584,716.92 in the overall cost of production for shift A without affecting the total production. In other words the same labor should have to increase production for shift A with a ratio of 0.025986339.

The shift B and shift C variable have not been obtained basic variable but the nature of application is exactly same, therefore the same results can also be applied on shift B and C respectively.

Total impact per day shown in the below table

Shifts	Current Labor	Reduction	Proposed	Cost Impact
A	250	6.496584721	243.5034153	584,716.92
B	220	5.716994555	214.2830054	514,550.89
C	195	5.067336082	189.9326639	456,079.20
Daily	665	17.28091536	647.7190846	1,555,347.01

These result shows that Daily 17 persons are working surplus having the cost impact of Rs.1, 555,347.01 per day.

CONCLUSION AND RECOMMENDATIONS

This research study has given approaching into how best manpower can be effectively planned so that minimum cost could be realized with available maximum shift wise production capacity & maintenance. The study is versatile and it can be adapted to all facts of economy such as manufacturing, refineries, textiles, pharmaceutical industries etc. to effectively plan for manpower based on available maximum shift wise production capacity and maintenance. The study can be enlarging to take care of more than two constraints. With this enlargement, the model will be more robust and the solution can be got through several iteration using simplex tableau.

Below are the Quarterly results showing current labor utilization, proposed labor and shift wise cost impact of the whole research.

Evaluation of Quarter from July to September

Shifts	Current Labor	Reduction	Proposed	Cost Impact
B	220	12.283311	207.7166893	652,659.99
A	250	13.958308	236.0416924	741,659.08
C	195	10.88748	184.11252	578,494.08
Daily basis	**665**	**37.129098**	**627.8709017**	**1,972,813.16**

Evaluation of Quarter from October to December

Shifts	Current Labor	Reduction	Proposed	Cost Impact
A	250	6.4965847	243.5034153	584,716.92
B	220	5.7169946	214.2830054	514,550.89
C	195	5.0673361	189.9326639	456,079.20
Daily basis	**665**	**17.280915**	**647.7190846**	**1,555,347.01**

Further the Evaluation for the whole year (on average basis) can be seen in table given below.

Evaluation for the whole year (Average)

Shifts	Current Labor	Reduction	Proposed	Cost Impact
A	250	7.709876	242.290124	576,571.34
B	220	6.7504565	213.2495435	504,322.88
C	195	5.9833592	189.0166408	447,013.46
Daily basis	**665**	**20.443692**	**644.5563083**	**1,527,907.68**

The average result shows that Daily 20 persons are working surplus having the cost impact of Rs.1, 527,907.68 per day. Also the table shows Shift wise reduction, proposed and labor cost impact which may be saved without disturbing maximum production.

References

1. Aderoba, A. A. (2000). Manpower planning for new job shops. *Nigerian Journal of Engineering and Management.* 1: 24-34.
2. Angel, E. (1986). From Dynamic Programing to fast transforms. Journal of Mathematical Analysis and

Applications. 119: 82-89.
3. Aust, R. J. (1976). Dynamic Programming branch and bound algorithm for pure integer programing. *Computers and Operations Research*, 3: 27-28.
4. Axsater, S. (1987). An extension of the extended basic period approach for economic lot scheduling problems. Journal of Optimization Theory Applications, 52: 179-189.
5. Banjoko, S. A. (1996). *Human Resource Management: An Expository Approach*, Saban Publishers, Lagos.
6. Dantzig, G. B. (1963). *Linear Programming and Extensions* , University Press ,Princeton, N.J.
7. Fajana, S. (2002). *Human Resource Management*: Labofin and company Publisher, Labos Island, Nigeria.
8. Fapetu, O. P., & Kareem, B. (2003). An effective manpower planning approach for maintenance Department: Global Journal of Pure & applied Sciences. 2: 2.
9. Fite, W. L. (1953). Maximization of return from limited resources. Journal of the Society for Industrial and Applied Mathematics, 1: 73-90.
10. Folayon, O., (1998). *Personal Management: Theories and issues*, Panaf Publishing, Lagos.
11. George. P. W. (1976). Bibliographic survey of quantitative approaches to manpower planning. Cambridge, Mass. : M.I.T. Alfred P. Sloan School of Management.
12. Ibaraki. T. (1978). Branch and bond procedure, and state-space representation of combinational optimization problems. J. Inform. Control, 36: 1-27.
13. Kareem. B. & Aderoba, A. A. (2004). Local content development in Nigerian economy. Proceeding of 2004. National Engineering conference and Annual General meeting, Waari.
14. Lindely, R. H. (1988). *Maintenance Engineering Handbook*. USA. McGraw Hill Inc.
15. Lucey, T. (2009). "*Management Information System*" (6th ed.). The Guernsey Press Co. Ltd. 1991. Reprinted in 1992 .
16. O' Brien, J. A. (1976). "*Management Information Systems": Managing information technology in the E-business enterprise* (5th Edition). USA: McGraw-Hill Inc.
17. Rao, P.S., & Rao. V.S.P. (1993). *Personnel and Human Resource Management: Text, Cases and games*, Kanast Publishers PVT. Ltd., pp: 220.
18. Shaw, L. (1976). Buy period control of queues based on waiting time at arrivals. J. Operation. Res. Soc. Am., 24: 10-14.
19. Sodiku. J. I. (2001). Planning for Scheduled maintenance work in Nigerian industries. *Nigerian Journal of Engineering and Management*, 2: 20-24.
20. Taha, H. A. (1987). *Operation Research: An introduction*. Macmillan, Inc., USA.
21. Vetter E.W.,(1967). Manpower Planning for High Talent Personnel. *Bureau of industrial Relations, University of Michigan.*
22. Werbel, D. J. & DeMarie, S.M "Aligning Strategic Human Resource Management," *Human Resource Management Review*, 15, 247–262.