

Decision Making For Recruitment and Promotion Policies Using Linear Programming

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ABSTRACTS

Optimizing decision is one of the procedures used for maximization of benefit with minimization of cost. To achieve a meaningful development in any organization, proper allocation of funds is needed with minimized cost. There would be no meaningful development in any organization that will not involve recruitment and promotion. The method used in this study for optimizing a manpower recruitment and promotion is linear programming approach, proposing a model and applying the model on data collected from hypothetical data for optimizing recruitment and promotion for N-grade manpower system. The output from the research was able to identify the total costs of recruitment is 17,433,800 (seventeen million, four hundred and thirty-three thousands, eight hundred naira) with 22 (twenty-two recruited staff. The total costs for promotion is 10,297,800 (ten million, two hundred and ninety-seven thousands, eight hundred naira) with 22 (twenty-two) staff promoted. From the model formulated, it can be applied by other organization considering recruitment and promotions of staff with a minimized cost for the manpower system when faced with limited available resources.

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INTRODUCTION

Manpower are people in their various roles as contributors to the production of goods and services. (Urhoma 2009). Nwichi & Chukwuka (2017) opined that manpower planning is a process whereby course of actions are determined in advance and continually updated with the aim of ensuring that; (a) the organization's manpower demand meet its projected needs is accurately predicted as the adoption of modern forecasting techniques allow and (b) the supply of labor (manpower) to the organizations maintained by deliberate and systematic action to mobilize it in reasonable balance with these demand.

Manpower planning is the same thing as Human Resource, its planning consists of putting right number of people into the right kind of place at the right time, doing the things for which they are suited for the achievement of the organization goal, Al Shobaki, Abu-Amuna & Abu-Naser (2016).. Manpower planning involves analyzing the current manpower inventory, making future manpower forecasts, developing employment programs and designing training program for employees.

Al Shobaki et al (2016) states that manpower planning involves; (a) the recruitments of sufficient and suitable staff for an organization. (b) the retention in the organization (c) the optimum utilization of staff and (d) the improvement of staff performance through training and retrenchment or disengagement of staff as necessary. Cole (2005) identified three major categories of staff that are important in manpower planning: (i) existing staff, (ii) new recruits and (iii) leavers. Each of these categories requires different decision to be made by the managers concerned, and these are stated thus;

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Many research works have been carried out by different researchers on manpower planning problem. The approach has always been either by using goal programming, dynamic programming, Markov chain or integer programming Amaran, Zhang, Sahinidis, Sharda, & Bury (2016). There has been no specific reference to linear programming approach with respect to manpower planning models, rather emphasis were based on dynamic programming approach.

Dany & Torchy (2017) defines Recruitment and selection as the process of attracting individuals on a timely basis, in sufficient numbers and with appropriate qualifications. The selection process includes screening applications and resumes, testing and reviewing work samples, interviewing, checking references and background. Organizations use this process to increase the likelihood of hiring individuals who possess the right skills and abilities to be successful at their jobs (Dany, et al (2017)).

The challenge for many researchers has been to demonstrate how recruitment selection can be derive scientifically to add value to Organization's performance. Recruitment and selecting staff is expensive both in terms of time and money, and it is therefore important that the process is carried out effectively and efficiently so that the results in the appointment of a person would fits the job being occupied.

Linear Programming (LP) is the must use mathematical technique designed to help manage in planning and in decision making to resource allocation. It is a mathematical method developed in determining a way to achieve best outcome in a given mathematical model for some list of requirement represented as linear relationships as opined by Akpan & Iwok (2016).

Many decisions reached by management of organizations involve trying to make the most effective use of organization resources. These resources include machinery, labours, money, time, warehouse space or raw materi22als to produce good (machinery, furniture, food or cooking) all service (schedules for machinery and production, advertising policy orinvestment on).

Linear programming is a family of mathematical programming that is concerned with allocation of scarce or limited resources to several competing activities on the basis of given criterion of optimality. In statistics, linear programming (LP) is a special techniques employed in operation research for the purpose of optimization of linear function, subject to linear equality and inequality constraint. Linear programming determines the way to achieve best outcome, such as maximum profit or minimum cost in a given mathematical model and given some list of requirement as a linear equation. The technique of linear programming is used in a wide range as applications, including agriculture, industry, transportation, economics, health system, behavioral and social science and the military. Although many business organization see linear programming as a "new science" or recently development in mathematical history, but there is nothing new about the maximization of profit in any business organization, i.e in a production company or manufacturing company.

Linear programming was born during the Second World War with original intent of solving military logistics problems. It remains one of the used mathematical techniques in today's modern societies. The development of linear programming has been ranked among the most important scientific advances of the mid-20th century. Today it is a standard tool that has saved many thousands or millions of dollars for most companies or businesses of even moderate size in the various industrialized countries of the world. From report of various surveys, it has been shown that many production companies, particularly the ones operating in Nigeria are yet to know fully the application of linear optimizations. Sometimes many production companies are faced with problems of how to utilize the available resources in order to maximize profit; this is because the use of linear programming which brings a suitable quantitative approach of decision-making has not been fully applied.

Over the years, owing to increased competitions trailing recruitment and promotion, its procedures has evolves significantly with time in the Organization, Dany et al (2017). This

challenge has bereave the researchers with little or no idea than to develop a suitable technique to carry out these process without further abnormality.

However, little or no significance progress has been achieved in this regards as research in this area are scarcely in literature. This study is therefore motivated to propose the use of Linear Programming on Manpower system as a technique for organizational optimization. It is the researcher's view that the study will be able to answer pending questions in relative to what is responsible for the arbitral cost in recruitment and promotion policies in an organizations.

In the abundance of the available literature; the study will add to the existing knowledge and literature in manpower planning, through the use of linear programming for optimization. This research will also serve as a guide on how to manage cost of recruitments and promotion, assist strategic decision's makers in conducting promptly and timely recruitments and promotion with maximized benefit and minimized costs.

The study was limited to a modeled manpower system for a strategic framework with a reduced cost in recruitment and promotion stages in n-grade manpower planning system. We intend to use hypothetical data for ten (10) years planning horizon

LITERATURE REVIEW

The manpower process has to do with recruitment and selections, promotions, and wedges. Recruitment is the process of finding and engaging the people the organization needs as observed by Armstrong (2009). Selection is that part of the recruitment process concerned with deciding which applicants or candidates should be appointed to the jobs. Braton and Gold (2007) differentiate the two terms while establishing a clear link between them in the following way: Selection is the process by which managers and others use specific instruments to choose from a pool of applicants a person or persons more likely to succeed in the job(s), given management goals and legal requirements.

Promotion, normally vacancies that arise in the lower grade are filled up by recruitments whereas those in the higher grades are filled up by promotions. Further, promotions besides giving due recognition to proficiency and credibility of the employees reduce the chance of an efficient employee leaving the organization. Some of the promotion rules are given below: (i) The senior most in the grade is promoted. (ii) Promotion is given at random. (iii) Those who fill certain efficiency criterion along with some minimum completed length of service are promoted. As per the rule (i), the length of service is the sole criterion for promotion and hence the management can control it. The rule (ii) gives full freedom for the management to promote any employee of their choice, which also is not desirable. Normally rule (iii) is preferred. Some of the reasons, which influence the promotion policies, are (a) pressure (b) efficiency and (c) length of service.

Pressure, in a multi-graded hierarchical manpower system, a promotion policy that is associated with constant promotion probabilities leaves a proportion of employees qualified by completed length of service in a lower grade un-promoted. This proportion increases and pressure starts building up as time progresses. When pressure exceeds a certain level of control, a high proportion of un-promoted employees could have serious effect on the efficiency of the organization for several reasons such as productive loss and wastage.

Wastages When employees move from one grade to another, they are exposed to different factors influencing them to leave the organization. Various data indicate that the reasons for leaving can be classified into the following cases: (i) Discharge (ii) Resignation (iii) Redundancy (iv) Retirement (v) Medical retirement. There skills used for manpower selection of recruitment and promotions.

Manpower Planning (MPP) is the process of obtaining the correct number of people with the proper skills at the appropriate time in order to fulfill organizational human resources

need, Gilliard (2007). According to Ukpong, (2017), the aim of MPP exercise is to strike a balance between the input of new work and the throughput of completed work. MPP has attracted the attention of researchers in the past few years as a fruitful area, both for theoretical analysis and practical applications. MP analyst determines the number of people required, authorized, and available to operate, maintain, support, and provide training for the system.

The MPP models available in literature have extensively dealt with how changes take place in the system. There is much evidence in literature on modeling of manpower. Models have been developed for various constraints and operating policies under which the system operates. Although Human Resources (HR) is not often considered to entail much mathematical theory, MPP utilizes the mathematical model to generate solutions to MP scenarios, Gilliard (2007), state: “it is almost a quarter of a century since the term ‘manpower planning’ came into general use but the mathematical treatment ‘manpower’ system must be as old as the planning of the military and building exploits of the ancient world. There are two features of most MPP problems which render them suitable for mathematical treatment. The first is concern with ‘Aggregates’. MPP unlike individual career planning is concerned with members, that is, with having the right number in the right place at the right time. The second feature of MPP which calls for mathematical expertise is the fact of ‘Uncertainty’. This arises both from the uncertainty of the social and economic environment in which organization operates and from the unpredictability of human behavior”.

The study by Ukpong, (2017) opined that, nowadays, there are three main directions in which research has been channeled. The first, the application of mathematical programming, second, research has been on stochastic process approaches, and thirdly, and potentially, fruitful avenue of research has been to explain turnover behavior as a function of various personal, professional and organizational factors.

Wang, (2005) reviewed Operation Research Applications in workforce planning and potential modeling of military training. The models were decomposed into four major categories; Optimization models, Markov chain models, computer simulation models and supply chain management models through system dynamics (SDs). Each category was reviewed for underlying mathematical formulations and concepts, advantages and potential limitations.

Models tend to explore manning situations beyond the range of direct observation. Some of these models consulted as an alternative approach to MPP is based on optimization theory. Optimization models are very powerful normative models, which can be compute an optimal set of personnel decisions (on recruitment, promotion, wastage, training etc) against goal stated in some forms of objectives functions. Majamaa, B. (2021), Optimization using Adjusted Program Budget Marginal-Analysis (PBMA) for Decision Making Process and Budget Planning Purposes. Considered optimizing choices in strategies used for improving the university ratings

Linear programming (LP) model based on Integer Programming (IP) to determine effective (optimal size) of manpower to be engaged is constructed by Akinyel (2007).. Cai, Li, and Tu (2004) proposes a multi-stage decision making in labor process (MDP) constrained MPP model to address the need of decision making in labor intensive organization facing dynamic fluctuations in their MP demand. This research will used linear programming process in optimizing the manpower recruitment and promotion exercise for maximization of benefit and minimizing the cost.

RESEARCH METHODS

The study shall adopt Ex-Facto Research Design, the data used in the study were hypothetical in nature for any manpower system. The data included the total of; number of recruitment per year R_d , fixed recruitment cost per year C_r , number of promoted per year P_d , and fixed promotion cost per year C_p , for ten (10) years periods ie $n = 1, 2, \dots, 10$.

The data for this study is a hypothetical data to covers ten (10) years planning horizon, from 2009 - 2019. The hypothetical data will serve as inputs to the LP model in equation 7 and 8 respectively, to obtain the minimum costs for recruitment and promotion in the Organization.

Table 1. Set of Data for a Ten Year Planning Period

Year	R _d	R _{dh}	C _r	P _d	P _{dh}	C _p
2009	89	9114	811139	51	13171	671707
2010	44	20735	912340	20	22000	440000
2011	62	13423	832231	24	27500	660000
2012	71	11705	831049	48	10833	520421
2014	35	23320	991200	18	49750	895500
2015	99	8303	822034	39	15931	621310
2016	66	12411	819107	46	6000	276000
2017	39	24276	946747	44	8441	371408
2018	58	14304	829642	36	14423	519231
2019	44	20941	921412	40	16833	673320

The general linear programming model with n decision variables and m constraints can be stated in the following form.

Optimize (Min) $Z = C_1 X_1 + C_2 X_2 + \dots + C_n X_n$

S. t

$a_{11} x_1 + a_{12} x_2 + \dots + a_{1n} (<, =, >) b_1$

$a_{21} x_1 + a_{22} x_2 + \dots + a_{2n} (<, =, >) b_2$

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$a_{m1} x_1 + a_{m2} x_2 + \dots + a_{mn} x_n (<, =, >) b_n$

(3)

The above model can be expressed in a compact form as follows;

Optimize (Min) $Z = \sum_{j=1}^n c_j x_j$ — — — (objective function)

Subject to the linear constraints

$\sum_{j=1}^n a_{ij} x_j (<, =, >) b_i, i = 1, 2, \dots, m$ and

$x_j \geq 0, j = 1, 2, \dots, n$

(4)

where C_1, C_2, \dots, C_n represent the per unit cost of decision variables X_1, X_2, \dots, X_n to the value of the objective function.

And $a_{11}, a_{12}, \dots, a_{1n}, \dots, a_m, a_{m1}, \dots, a_{mn}$ represent the cost per demand for recruitment/promotion of the decision variables.

The b_i represent the total availability of i th demand for recruitment/promotion.

Z represent the measure -of-minimize cost.

Notations

Rd: = Recruitment demand

Pd: = Promotion demand

Cr: = Recruitment cost per demand

Cp: = Promotion cost per demand

$\sum Cr$: = sum total for the recruitment cost
 $\sum Cp$: = sum total for the promotion cost

Since we have to satisfy all requirement, the recruitment and promotion mathematical models are as follows :

$$\left. \begin{array}{l} \text{a. } \sum_{j=1}^n R_{dij} x_{ij} \geq \sum C_{rij}, i = 1, 2, \dots, n \text{ and} \\ X_j, x_{ij} \geq 0, (\text{for all } i \text{ and } j). \end{array} \right\} \quad (7)$$

$$\left. \begin{array}{l} \text{b. } \sum_{j=1}^n P_{dij} x_{ij} \geq \sum C_{pij}, i = 1, 2, \dots, m \text{ and} \\ X_j, x_{ij} \geq 0, (\text{for all } i \text{ and } j). \end{array} \right\} \quad (8)$$

RESULTS

To evaluate the Organizational cost for Recruitment and Promotion policy, two models were constructed. There are; Model

1. A: To minimize Recruitment cost in the Organization for a ten years planning.
2. Model B: To minimize Promotion cost in the Organization for a ten years period.

Main while, the following decision variables were used in the models:

- X1 = Total cost for Recruitment and Promotion for year one.
- X2 = Total cost for Recruitment and Promotion for year two.
- X3 = Total cost for Recruitment and Promotion for year three.
- X4 = Total cost for Recruitment and Promotion for year four.
- X5 = Total cost for Recruitment and Promotion for year five.
- X6 = Total cost for Recruitment and Promotion for year six.
- X7 = Total cost for Recruitment and Promotion for year two.
- X8 = Total cost for Recruitment and Promotion for year eight.
- X9 = Total cost for Recruitment and Promotion for year nine.
- X10 = Total cost for Recruitment and Promotion for year ten.

The data requirements that need to be fit into the models are as presented in table 3.1

Model A

Objective function: To minimize the total cost for recruitment in the organization for a ten years period.

$$\text{Min } f(x) = 811,139 \cdot x_1 + 912,340 \cdot x_2 + 832,231 \cdot x_3 + 831,049 \cdot x_4 + 991,200 \cdot x_5 + 822,034 \cdot x_6 + 819,107 \cdot x_7 + 946,747 \cdot x_8 + 829,642 \cdot x_9 + 921,412 \cdot x_{10};$$

Subject to these constraints:

1. The total recruitment needed for year 1 is two (2) with the reduced cost of 811,139.
 $80.1 \cdot x_1 \geq 89$;
2. The total recruitment needed for year 2, is two (2) with the reduced cost of 912,340.
 $39.6 \cdot x_2 \geq 44$;
3. The total recruitment needed for year 3 is two (2) with the reduced cost of 832,231.
 $55.8 \cdot x_3 \geq 62$;
4. The total recruitment needed for year 4 is two (2) with the reduced cost of 831,049.
 $63.9 \cdot x_4 \geq 71$;
5. The total recruitment needed for year 5 is two (2) with the reduced cost of 991,200.
 $31.5 \cdot x_5 \geq 35$;
6. The total recruitment needed for year 6 is two (2) with the reduced cost of 822,034.

- $$89.1 \times x_6 \geq 99;$$
7. The total recruitment needed for year two 7 is (2) with the reduced cost of 819,107.
 $59.4 \times x_7 \geq 66;$
 8. The total recruitment needed for year 8 is two (2) with the reduced cost of 946,747.
 $35.1 \times x_8 \geq 36;$
 9. The total recruitment needed for year 9 is two (2) with the reduced cost of 829,642.
 $52.2 \times x_9 \geq 58;$
 10. The total recruitment needed for year10 is two (2) with the reduced cost of 921,412.
 $39.6 \times x_{10} \geq 44;$

90 percent of the total recruitment required with minimum cost and optimized objective with the following constraints.

$$80.1 \times 1 + 39.6 \times 2 + 55.8 \times 3 + 63.9 \times 4 + 31.5 \times 5 + 89.1 \times 6 + 59.4 \times 7 + 35.1 \times x_8 + 52.2 \times 9 + 39.6 \times x_{10} \geq 607;$$

$$X_i \geq 0 \text{ and integer, } i = 1, 2, 3, \dots, 10.$$

The optimal result obtained via Ling 12.0 (please refer to Appendix) and summarized on table, in Table 4.3.

Model B

Objective function: To maximize the total cost for recruitment if the organization budgets is 15,000,000 for a ten years period.

$$\text{Max } f(x) = 80.1 \times x_1 + 39.6 \times x_2 + 55.8 \times x_3 + 63.9 \times x_4 + 31.5 \times x_5 + 89.1 \times x_6 + 59.4 \times x_7 + 35.1 \times x_8 + 52.2 \times x_9 + 39.6 \times x_{10};$$

Subject to these constraints:

1. The total recruitment needed for year 1 is two (2) with an incurred cost of 80.100.
 $80.1 \times x_1 \geq 89;$
2. The total recruitment needed for year 2 is two (2) with the incurred cost of 36.600.
 $39.6 \times x_2 \geq 44;$
3. The total recruitment needed for year 3 is two (2) with the incurred cost of 55.800.
 $55.8 \times x_3 \geq 62;$
4. The total recruitment needed for year 4 is two (2) with the reduced cost of 63.900.
 $63.9 \times x_4 \geq 71;$
5. The total recruitment needed for year 5 is two (2) with the incurred cost of 31.500.
 $31.5 \times x_5 \geq 35;$
6. The total recruitment needed for year 6 is one hundred and sixty-three (163) with the incurred cost of 89.100.
 $89.1 \times x_6 \geq 99;$
8. The total recruitment needed for year two 7 is (2) with the incurred cost of 59.400.
 $59.4 \times x_7 \geq 66;$
9. The total recruitment needed for year 8 is two (2) with the incurred cost of 35.100.
 $35.1 \times x_8 \geq 36;$
10. The total recruitment needed for year 9 is two (2) with the incurred cost of 82 52.200.
 $52.2 \times x_9 \geq 58;$
11. The total recruitment needed for year10 is two (2) with the incurred cost of 39.600.
 $39.6 \times x_{10} \geq 44;$

90 percent of the total recruitment required with maximum cost and optimized objective with the following constraints.

$$811,139 \cdot x_1 + 912,340 \cdot x_2 + 832,231 \cdot x_3 + 831,049 \cdot x_4 + 991,200 \cdot x_5 + 822,034 \cdot x_6 + 819,107 \cdot x_7 + 946,747 \cdot x_8 + 829,642 \cdot x_9 + 921,412 \cdot x_{10} \leq 15,000,000;$$

$$x_i \geq 0 \text{ and integer, } i = 1, 2, 3, \dots, 10.$$

The optimal result obtained via Ling 12.0 (please refer to Appendix) and summarized on table, in Table 4.3.

Model C

Objective function: To minimize the total cost for promotion in the organization for a ten years period.

$$\text{Min } f(x) = 671,707 \cdot x_1 + 440,000 \cdot x_2 + 660,000 \cdot x_3 + 520,421 \cdot x_4 + 895,500 \cdot x_5 + 621,310 \cdot x_6 + 276,000 \cdot x_7 + 371,408 \cdot x_8 + 519,281 \cdot x_9 + 173,320 \cdot x_{10};$$

Subject to these constraints:

1. The total promotion needed for year 1, is two (2) with the reduced cost of 671707.
 $46 \cdot x_1 \geq 51;$
2. The total promotion needed for year 2 is two (2) with the reduced cost of 440000.
 $18 \cdot x_2 \geq 20;$
3. The total promotion needed for year 3 is two (2) with the reduced cost of 440000.
 $22 \cdot x_3 \geq 24;$
4. The total promotion needed for year 4 is two (2) with the reduced cost of 520421.
 $43 \cdot x_4 \geq 48;$
5. The total promotion needed for year 5 is two (2) with the reduced cost of 895500.
 $16 \cdot x_5 \geq 18;$
6. The total promotion needed for year 6 is two (2) with the reduced cost of 621310.
 $35 \cdot x_6 \geq 39;$
7. The total promotion needed for year 7 is two with the reduced cost of 276000.
 $41 \cdot x_7 \geq 46;$
8. The total promotion needed for year 8 is two (2) with the reduced cost of 371408.
 $40 \cdot x_8 \geq 44;$
9. The total promotion needed for year 9 is two (2) with the reduced cost of 519281.
 $32 \cdot x_9 \geq 36;$
10. The total promotion needed for year 10 is two (2) with the reduced cost of 173320.
 $36 \cdot x_{10} \geq 40;$

90 percent of the total recruitment required with minimum cost and optimized objective with the following constraints.

$$46 \cdot x_1 + 18 \cdot x_2 + 22 \cdot x_3 + 43 \cdot x_4 + 16 \cdot x_5 + 35 \cdot x_6 + 41 \cdot x_7 + 40 \cdot x_8 + 32 \cdot x_9 + 36 \cdot x_{10} \geq 366;$$

$$x_i \geq 0 \text{ and integer, } i = 1, 2, 3, \dots, 10.$$

The optimal result obtained via Ling 12.0 (please refer to Appendix) and summarized on table, in Table 4.3.

Model D

Objective function: To maximize the total cost for promotion in the organization budgets of 11,000,000 for a ten years period.

$$\text{Min } f(x) = 46 \cdot x_1 + 18 \cdot x_2 + 22 \cdot x_3 + 43 \cdot x_4 + 16 \cdot x_5 + 35 \cdot x_6 + 41 \cdot x_7 + 40 \cdot x_8 + 32 \cdot x_9 + 36 \cdot x_{10};$$

Subject to these constraints:

1. The total promotion needed for year 1, is two (2) with the incurred cost of 46.00.
 $46 \times x_1 \geq 51$;
2. The total promotion needed for year 2 is two (2) with the 18.00ed cost of 440000.
 $18 \times x_2 \geq 20$;
3. The total promotion needed for year 3 is two (2) with the incurred cost of 22.00.
 $22 \times x_3 \geq 24$;
4. The total promotion needed for year 4 is two (2) with the incurred cost of 43.00.
 $43 \times x_4 \geq 48$;
5. The total promotion needed for year 5 is two (2) with the incurred cost of 16.00.
 $16 \times x_5 \geq 18$;
6. The total promotion needed for year 6 is two (2) with the incurred cost of 35.00.
 $35 \times x_6 \geq 39$;
7. The total promotion needed for year 7 is two with the incurred cost of 41.00.
 $41 \times x_7 \geq 46$;
8. The total promotion needed for year 8 is two (2) with the incurred cost of 40.00.
 $40 \times x_8 \geq 44$;
9. The total promotion needed for year 9 is two (2) with the incurred cost of 32.00.
 $32 \times x_9 \geq 36$;
10. The total promotion needed for year10 is six (6) with the reduced cost of 36.00.
 $36 \times x_{10} \geq 40$;

90 percent of the total recruitment required with minimum cost and optimized objective with the following constraints.

$$671,707 \times x_1 + 440,000 \times x_2 + 660,000 \times x_3 + 520,421 \times x_4 + 895,500 \times x_5 + 621,310 \times x_6 + 276,000 \times x_7 + 371,408 \times x_8 + 519,281 \times x_9 + 173,320 \times x_{10} \leq 11,000,000;$$

$$x_i \geq 0 \text{ and integer, } i = 1, 2, 3, \dots, 10.$$

The optimal result obtained via Ling 12.0 (please refer to Appendix) and summarized.

DISCUSSION OF FINDINGS

TABLE 2. Optimal result for Model A

Variable	Solution
X1	Two (2) recruits are needed in year 1, to reduced cost of 811,139
X2	Two (2) recruits are needed in year 2, to reduced cost of 912340 in the organizational
X3	Two (2) recruits are needed in year 3, to reduced 832,231 in the organization.
X4	Two (2) recruits are needed in year 4, to reduced cost of 831,049
X5	Two (2) recruits are needed in year 5, in other to reduced cost of 991,200
X6	Two(2) recruits are needed in year 6, in to reduced cost of 822,034
X7	Two (2) recruits are needed in year 7, to reduced organizational cost of 819,107
X8	Two (2) recruits are needed in year 8, to reduced cost of 946,747
X9	Two (2) recruits are needed in year 9, to reduced cost of 829,642
X10	Two (2)recruits are needed in year 10, to reduced organizational cost of 921,412
Total budget need	17,433,800

TABLE 3. Optimal result for Model B

Variable	Solution
X1	Two (2) recruits are needed in year 1, with additional cost of 80.10
X2	Two (2) recruits are needed in year 2, with additional cost 39.600 of in the organizational
X3	Two (2) recruits are needed in year 3, with additional cost 55.80 in the organization.
X4	Two (2) recruits are needed in year 4, with additional cost of 63.90
X5	Two (2) recruits are needed in year 5, with additional cost of 31.50
X6	One hundred and sixty-three (163) recruits are needed in year 6, with additional cost of 89.10
X7	Two (2) recruits are needed in year 7, with additional cost of 59.40
X8	Two (2) recruits are needed in year 8, with additional cost of 35.10
X9	Two (2) recruits are needed in year 9, with additional cost of 52.20
X10	Two (2) recruits are needed in year 10, with additional cost of 39.60
Total budget need	15,000,000

TABLE 4. Optimal result for Model C.

Variable	Solution
X1	Two (2) persons are needed to be promoted in year 1, to reduced organizational cost of 671,707
X2	Two (2) persons are needed to be promoted in year 2, to reduced organizational cost of 440,000
X3	Two (2) persons are needed to be promoted in year 3, to reduced organizational cost of 660,000
X4	Two (2) persons are needed to be promoted in year 4, to reduced organizational cost of 520,421
X5	Two (2) persons are needed to be promoted in year 5, to reduced organizational cost of 895,500
X6	Two (2) persons are needed to be promoted in year 6, to reduced organizational cost of 621,310
X7	Two (2) persons are needed to be promoted in 7, to reduced organizational cost of 276,000
X8	Two (2) persons are needed to be promoted in year 8, to reduced organizational cost of 371,408
X9	Two (2) persons are needed to be promoted in year 9, to reduced organizational cost of 519,281
X10	Two (2) persons are needed to be promoted in year 10, to reduced organizational cost of 173,320
Total budget need	10,297,890

TABLE 5. Optimal result for Model D.

Variable	Solution
X1	Two (2) persons are needed to be promoted in year 1, to reduced organizational cost of 671,707
X2	Two (2) persons are needed to be promoted in year 2, with an incurred organizational cost of 18.00

X3	Two (2) persons are needed to be promoted in year 3, with an incurred organizational cost of 22.00
X4	Two (2) persons are needed to be promoted in year 4, with an incurred organizational cost of 43.00
X5	Two (2) persons are needed to be promoted in year 5, with an incurred organizational cost of 16.00
X6	Two (2) persons are needed to be promoted in year 6, with an incurred organizational cost of 35.00
X7	Two (2) persons are needed to be promoted in year 7, with an incurred organizational cost of 41.00
X8	Two (2) persons are needed to be promoted in year 8, with an incurred organizational cost of 40.00
X9	Two (2) persons are needed to be promoted in year 9, with incurred organizational cost of 32.00
X10	Six (6) persons are needed to be promoted in year 10, with an incurred organizational cost of 36.00
Total budget need	11,000,000

MODELS RESULT COMPARISON

Model A and B

From results presented by LINGO 12.0, the following can be deduced from the models of A and B.

1. Total budgets for A is 17,433,800 with recruits of two (2) in every year considering the ten (10) years period plan and reduced costs at every year as shown in Table 4.1
2. Total budgets for B is 15,000,000 with recruits of two (2) in every year considering the ten (10) years period plan with exception of year six (6) that has recruits of 163 and with an incurred cost at every year as shown in table 4.2

In conclusion, it is empirically clear that model A has exhibited the best optimum solution owing by the reduced cost in recruitment, thereby keeping totally in line with the study objectives..

Model C and D

From results presented by LINGO 12.0, the following can be deduced from the models of C and D.

1. Total budgets for C is 10,297,890 with promotions of two (2) in every year considering the ten (10) years period plan and reduced costs at every year as shown in table 4.3
2. Total budgets for D is 11,000,000 with recruits of two (2) in every year considering the ten (10) years period plan with exception of year ten (10) that has promotions of 6 and with an incurred cost at every year as shown in table 4.4

In conclusion, it is empirically clear that model C has exhibited the best optimum solution owing by the reduced cost in promotion, thereby keeping totally in line with the study objectives.

SUMMARY

In line with the idea of Linear Programming Applications; our approach has the advantage that has an attempt made for the first time through Linear Programming to obtain the optimal number of recruits and promotions to be made so that the total cost incurred is minimal on manpower planning system, in the area of recruitment and promotion costs

The study explicitly looked at how reduced costs can be achieved in recruitment and promotion by applying Linear Programming model. The actionable model has been found to be reliable and efficient in terms of result attainability.

CONCLUSION

In contrast to Linear Programming (LP) there does exist a standard mathematical formulation of the LP problem, however, LP is a general type of approach to problem solving, and the research equation used were developed to fit each situation.

Therefore, a certain degree of ingenuity and insight into the structure of LP problems is required to recognize when and how a problem can be solved by LP procedures. This study has delineated myriads of LPs applications areas. This shows the versatility of LP by presenting a manpower planning problem as a linear decision Program, LP can be applied to control a manpower decision making process.

We have identified various costs for manpower system that serves as inputs to mathematical model so developed. We also formulated the LP optimization version of the mathematical model.

This gives us a recursive mathematical optimization which is found to behave the same as the W.W.A in production/inventory management. The actionable model minimizes the manpower system procedure, recruitment and promotion periods that are determined by the changes that takes place in the system. This is confirmed by a numerical example run on hypothetical data. This study was limited to modeling a manpower system that negated a strategic framework that reduced cost of recruitment and promotion stages in n-grade manpower planning system. And as such the work was carried out within the confines of Linear Programming. Further research is needed in this topic to cover other components manpower in a view to reducing organizational costs.

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