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KVANTITATIVNE METODE U ORGANIZACIJSKOM DIZAJNU: MODEL I PRIMJENA U STVARNOM SVIJETU

QUANTITATIVE METHODS IN THE DESIGNS OF ORGANIZATIONS: A MODEL AND A REAL WORLD APPLICATION

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Pregledni rad

Sažetak: *Glavni problem u organizacijskom dizajnu je problem određivanja optimalnog broja potrebnih zaposlenika. Javne službe u zemljama u razvoju i pružatelji usluga posebno su suočavaju s ovim izazovom. Uz zapošljavanje koje se ne temelji na zahtjevu organizacije javlja se prevelik broj zaposlenih. U ovom je istraživanju struktura proizvodne organizacije u državnom vlasništvu redizajnirana pomoću modela iskoristivosti kadra u svrhu optimizacije radnih uvjeta. Korištenjem metode trenutačnih opažanja utvrđeni su godišnji sadržaj rada i optimalni broj zaposlenika na operativnoj razini. Dinamički parametri ljudske interakcije određeni su za tri razine upravljanja i korišteni su za dobivanje optimalnih raspona kontrole za upravljačke pozicije. Čimbenici iskoristivosti kadra i godišnji troškovi rada izračunati su za postojeće i redizajnirane strukture. Rezultati pokazuju da bi se čimbenik iskoristivosti kadra tvrtke mogao povećati za 0,4787 do 0,8063 te bi uštede na godišnjoj razini mogle iznositi N8 018 544. Može se zaključiti da se pomoću kvantitativnog pristupa organizacijskome dizajnu mogu učiniti značajne uštede. Gubitci se mogu smanjiti, što rezultira poboljšanjem produktivnosti.*

Ključne riječi : *Dizajn, Optimalno, Organizacija, Osoblje, Javna služba, Kvantitativno****.***

Review article

Abstract: *A major problem in organizational design is the problem of determining the optimum number of personnel required. Public Service organizations in developing countries and service providers are particularly faced with this challenge. With employment not based on organization's requirement, overstaffing results. In this study, the structure of a publicly owned production organization was redesigned, using human utilization model to optimize its labour requirement. Using Work Sampling Method, annual work content and optimal numbers of employees were determined at the operational levels. Human interaction dynamic parameters were determined for three management levels and used to obtain the optimal spans of control for the management positions. Human utilization factors and annual costs of labour were computed for the existing and the redesigned structures. The results show that the human utilization factor of the company could be increased from 0.4787 to 0.8063 and savings of N8, 018, 544 made annually. It can be concluded that by using quantitative approach to organizational design, significant savings can be made. Wastages can be reduced and productivity improvement results.*

Keyword : *Design, Optimum, Organization, Personnel, Public service, Quantitative****.***

1. INTRODUCTION

To achieve improved productivity objectives, researchers have applied the principles of statistics, dynamics, thermodynamics and economics to select machines, tooling and materials processing parameters [1]. Moreover, there has been series of engineering approaches for designing of human work environments; however, information is sparse on similar procedures for organizational structure design [2].

Burton [3] stated that organization design addresses two fundamental issues of how to divide the organization's work into smaller units and then how to reassemble those parts into a meaningful whole. These naturally lead to complexity and interdependence and are at the heart of organization design [4]. Kulik and Baker [5] suggested that any proposed model should be based on the characteristics of the type of organization for which development is being done and the influence of the environment. Drucker [6] called for systematic approach to organizational design. Galbraith et al. [1] introduced the matrix type of organization structure in which a person may report to 2 or more superiors.

Vancil [7] reported that most organization structures are hybrid. Hammar and Champy [8] argued that the traditional models of hybrid, functional, divisional or matrices are obsolete in this time of information technology and did not lend themselves to team cooperation and continuous performance improvements. They therefore introduced Business Process Re-engineering Organization Structure (BPR) which they defined as the fundamental rethinking and radical redesign of business process to achieve dramatic improvement in critical measures of performance such as cost, service quality and speed.

Hax and Majluf [9] investigated the possibility of using the operations research paradigm of theory, alternatives, criteria, evaluation and choice for organizational design and criticized the existing theory for lack of quantitative structure that would lend itself to mathematical model.

Charles-Owaba [10] adopted the engineering methodology to organizational design through the use of operational research paradigm of theory, alternatives, criteria evaluation and choice. He postulated that the present-day organization could be represented by a quantitative structure which means that they can lend themselves to mathematical models. This is a major breakthrough in the area of quantitative design of organizational structure for optimal performance. The queuing theory [11] was used to develop quantitative model that combined the parameters and variables of an organization. Ismaila et al. [12] had also used the queuing theory to determine the manpower requirement in a manufacturing company. Public or government establishment is often structurally complex. The number of hierarchical management levels is usually numerous and sometimes difficult to specify, though the objectives, goals and tasks of each company may be well stated and defined in the organizational blueprint. The commonly observed effects of such complex structure are low personnel utilization and high level of ineffectiveness and inefficiency in the system. The reason for this may well be associated to politics and government policy.

Usually, the opposite is the case in a typical non-public service organization, in which three (3) distinct management levels are often identifiable – the top management, supervisory and operating management levels. This may be the reason organizations are more effective and efficient than the government owned companies especially in developing countries. The number of management (decision) levels may be a major factor that determines the performance of an organization. The reason for this is that information flow time is a function of a number of decision or management levels. In other words, if there exist numerous decision levels, huge time is taken for information to flow from the top (executive) to the operating level, thereby delaying the actions to be carried out at the operation level. The present study therefore investigates the present organizational structure and hence, personnel interaction dynamics and proffer more efficient structure using a quantitative approach.

The human interaction dynamics and network in a company was investigated. The main activity of the company is asphalt production and laying. The company was designed to produce 500 tonnes of asphalt per day.

2. MATERIALS AND METHODS

2.1 Theoretical Framework and Model Development

The proposition that creates a theoretical basis for quantitative design of organizational structure is stated thus: “a non-fully automated business organization is personnel – personnel or personnel-machine interactional, stochastic and dynamic decision and operation work system” [10]. This proposition, together with some other mathematical functions [13-14] serves as the basis for quantitative design of organizational structure. A mathematical model was advanced which relates personnel utilization to the parameters and variables of an organizational structure. The following assumptions were adopted:

1. Every employee has at least one job to perform in the organization.
2. The organization has terminal (or operational) activities distinct from the supervisory and pure decision activities.
3. Every employee is sufficiently motivated.
4. Every employee is assigned and responsible to one and only one boss (i.e. one-boss structure).
5. Standard workload (suitable for the position) and not maximum possible workload is assigned to every staff.
6. The workload of a superior (boss) at decision center (i, j) is proportional to his/her span of control K.
7. Regular features of superior-subordinate relationships are those associated with requests, response to directives, situational reporting, clarifications, authorizations and counseling.
8. Arrival of cases for and departure from a superior (boss) are stochastic events.
9. First come, first served consultation discipline is observed; the superior attends to one subordinate’s case at a time.
10. A superior is experienced enough to handle a decision center, otherwise, there will be a large heap of cases at every moment.
11. A boss in charge of a decision position oversees only the specific number of immediate subordinates (k_{ij}) assigned to him/her.
12. The time a subordinate leaves his/her location and travels to the superiors’ is negligible.

These conditions are those associated with one channel queuing model with restricted queue length and arriving population.

Based on the stated assumptions, the following notations are used in the personnel utilization model.

L_{ij} = Average number of subordinates for a superior or manager’s attention at decision center j and management level i, in a day.

W_{ij} = Average time (hours) a subordinate waits and receives attention from the boss.

P_{ij} = The proportion of time the superior has no subordinate to attend to.
K_{ij} = The span of control at decision center *j* of management level *i*.
A_{ij} = The amount of time (hours) scheduled for work in a day.

Denoting personnel utilization of decision center *j* at level *i* as H_{ij} and considering the definition of personnel utilization as:

$$\text{Personnel Utilization} = \frac{\text{Man-hours actually spent on useful work}}{\text{Total-hours provided for work}}$$

The personnel utilization model is thus expressed as:

$$H_{ij} = \frac{L_{ij}(A_{ij} - W_{ij}) + (K_{ij} - L_{ij})A_{ij} + (I - P_{ij})A_{ij}}{A_{ij}(K_{ij} + I)} \quad (1)$$

where $W_{ij} \le A_{ij}$

$L_{ij}(A_{ij} - W_{ij})$ = Average man-hours actually spent working by subordinates who for one information or the other have to consult the boss in a day.

$A_{ij}(K_{ij} - L_{ij})$ = Daily man-hours actually spent working by those subordinates who have no reasons to seek information from the boss.

$A_{ij}(1 - P_{ij})$ = Daily man-hours actually spent working by the head of decision center *j* at level *i*.

$A_{ij}(K_{ij} + 1)$ = Daily man-hours scheduled for work by subordinate and superior at decision center *i, j*.

If equation (1) above is simplified, we obtain the equation (2):

$$1 - \frac{L_{ij} \times W_{ij}}{A_{ij}(K_{ij} + 1)} - \frac{P_{ij}}{(K_{ij} + 1)} \quad (2)$$

Equation (2) gives the personnel utilization at decision center *j* and management level *i*. If there are *M* management levels and N_i number of decision centers (job positions) at level *i*, then, for the entire organization, the personnel utilization *H*, will be given as follows:

$$H(K_{ij}, M, N_i, \theta_h) = \frac{\sum_{i=1}^{K_{ij}} \sum_{j=1}^{M} H_{ij}}{\sum_{i=1}^{M} N_i} \quad (3)$$

Where $\theta_h = \{A_{ij}, \lambda_{ij}, \mu_{ij}, N_o\}$ is the set of parameters.

Since the conditions given earlier are those associated with one channel queuing model with restricted queue length, the Kendall-Lee notations are used (Taha, 2006).

That is, the queuing system is $\left(\frac{M}{\frac{M}{1}}\right) : \left(\frac{FCFS}{K_{ij}}\right)$

where;
M: Poisson arrival/departure distribution
1: One server
FCFS: First come, first served, queue discipline
L_{ij} and K_{ij} : As earlier defined.

For a queue system in a steady state, the following notations are used:

μ_{ij} : The rate at which the superior at decision center *j*, level *i* attends to his/her subordinates.

λ_{ij} : The rate at which the subordinates arrive to consult the superior

$$\rho_{ij} = \frac{\lambda_{ij}}{\mu_{ij}} \text{ and } \mu_{ij} \langle \lambda_{ij}$$

Where ρ_{ij} is called the traffic intensity and $0 \le \rho_{ij} \le 1$.

Also, the following expressions (Taha, 2007) are employed

$$L_{ij} = I_{ij} + 1 - P_{ij} \quad (4)$$

$$W_{ij} = \frac{I_{ij}}{[\mu_{ij}(1 - P_{ij})] + \left(\frac{1}{\mu_{ij}}\right)} = \frac{[I_{ij} + 1 - P_{ij}]}{[\mu_{ij}(1 - P_{ij})]} \quad (5)$$

$$P_{ij} = \left[1 + \sum_{n=1}^{K_{ij}} C_n^{K_{ij}} n! \rho_{ij}^n\right]^{-1} \quad (6)$$

$$I_{ij} = \frac{\left[\sum (n-1) C_n^{K_{ij}} n! \rho_{ij}^n\right]}{\left[1 + \sum C_n n! \rho_{ij}^n\right]} \quad (7)$$

Where $\rho_{ij} = \frac{\lambda_{ij}}{\mu_{ij}}$, and

$$H_{ij} = 1 - \frac{L_{ij} \times W_{ij}}{A_{ij}(K_{ij} + 1)} - \frac{P_{ij}}{(K_{ij} + 1)} \quad (8)$$

It is observed from expressions (4), (5), (6) and (7) above that L_{ij}, W_{ij} and P_{ij} are dependent mainly on μ_{ij} and λ_{ij}. Thus, we can express H_{ij} as a function of K_{ij}, A_{ij}, μ_{ij} and λ_{ij} as:

$$H_{ij} = H_{ij}(K_{ij}, A_{ij}, \mu_{ij}, \lambda_{ij}) \qquad (9)$$

We observe that A_{ij}, the man-hours provided for work in a day is a company's policy. μ_{ij} the superior attending rate and λ_{ij} the subordinates' consulting rate can be determined experimentally.

Thus, A_{ij}, μ_{ij} and λ_{ij} constitute the set of parameters of the personnel utilization function at decision center *j* at level *i*. The only variable is K_{ij}, the span of control. Therefore, H_{ij} can be maximized if K_{ij} is judiciously selected.

For the design of the entire organization structure, the personnel utilization is expressed as;

$$H_{ij} = H_{ij}(K_{ij}, M, N_i, \theta_h) = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N_i} H_{ij}}{\sum_{i=1}^{M} N_i} \qquad (10)$$

where $Q_h = \{A_{ij}, \lambda_{ij}, \mu_{ij}, N_O\}$ is the set of parameters.

N_O = The number of operation positions, number of employees who perform terminal activities. N_0 is an additional parameter, K_{ij}, M and N_i are variables to be judiciously determined, so that the value of *H* for the organization is maximized.

M = Number of decision (or management) levels.

N_i = Number of decisions (or management) positions at level *i*.

K_{ij} = As earlier defined (span of control)

N_1 = Number of supervisory positions, i.e. when *i* = 1

N_2 = Number of pure decision or management positions at management level 2

N_M = 1, is the topmost or chief executive position.

N_i is a variable but it becomes a parameter when *i* = 0.

This is, because the number of operations positions is determined by the amount of work or volume of operation, which is a company's policy. At this junction, it should be said that the fundamental organization structure design problem is to maximize the personnel utilization. Therefore, equation (10) above can be presented in the form as follows:

Maximize:

$$H_{ij}(K_{ij}, M, N_i, \theta_h) = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N_i} H_{ij}}{\sum_{i=1}^{M} N_i} \qquad (11)$$

Subject to:

$$\sum_{i=1}^{M}\sum_{j=1}^{N_i} K_{ij} = N_{i-1}$$

$N_M = 1$ and K_{ij}, N_i, M, > 0

where $\theta_h = (A_{ij}, \lambda_{ij}, \mu_{ij}, N_O)$, is the set of parameters.

The work here is to determine the values of the set of parameters $\theta_h = (A_{ij}, \lambda_{ij}, \mu_{ij}, N_O)$, and with the span of controls 3, 3 and 2 respectively for the three managers at the intermediate level, we found out that the values of personnel utilization are 0.9136, 0.9136 and 0.8416 respectively. Therefore, the personnel utilization at the intermediate level will be :

(0.9136 + 0.9136 + 0.8416) : 3 = 0.8896

The topmost manager has a span of control of 3 with human dynamic parameters $\lambda = 0.76$, $\mu = 2.51$
Thus, the personnel utilization of the topmost manager is 0.8857

Therefore we obtain the average utilization of the existing structure as:

$$\frac{(0.4160 \cdot 86) + (0.94785 \cdot 8) + (0.8896 \cdot 3) + (0.8857 \cdot 1)}{86 + 8 + 3 + 1} = 0.4787$$

2.2 Determining Human Utilization of the Redesigned Structure

In the redesigned structure, the number of operations positions has been reduced from 86 to 52 through a work sampling (or activity sampling) procedure as carried out above. The "use factor" of the company (which is 0.78) was employed to determine the actually needed number of operation positions as 52. Here, we take "use factor" and "personnel utilization" as synonymous (the same). Thus, the average personnel utilization of the workers at the operations positions in the redesigned structure is 0.78 or 78%.

The personnel utilization at supervisory level where there are 7 employees, in which four of them has span of control 7, each; and the remaining three has span of control 8, each; by using the human interaction dynamic parameters λ = 1.74, μ = 7.99, we obtain the average personnel utilization (Charles-Owaba, 2002) as follows:

For the four supervisors with span of control 7, the personnel utilization is 0.9706; while for the remaining three supervisors with span of control 8, each; the personnel utilization is 0.9698.

Therefore, the average personnel utilization at the supervisory level of the redesigned structure is:

$$\frac{(0.9706 \cdot 4) + (0.9698 \cdot 3)}{7} = \frac{3.8824 + 2.9094}{7} = 0.9703$$

At the intermediate level where there are 2 staff, each with span of control 4 and 3 respectively, the personnel interaction dynamic parameters are, λ = 1.26 and μ = 2.76, the personnel utilization is obtained as 0.9332 for the one with span of control 4, and 0.9136 for the other with span of control 3. Therefore, the average personnel utilization of the intermediate managers is

$$\frac{(0.93324 + 0.9136)}{2} = 0.9234.$$

For the topmost manager λ= 0.76, μ = 2.51 and span of control 2, the personnel utilization = 0.8017.
Thus, the human utilization of the entire organization for the redesigned structure will be

$$= \frac{(0.78 \cdot 52) + (0.9703 \cdot 7) + (0.9234 \cdot 2) + 0.8017}{52 + 7 + 2 + 1} = 0.8065$$

2.3 Determination of Cost Savings on Labour

Apart from a dramatic increase in human resource utilization, the resultant benefits of the rationalized (or redesigned) organizational structure include huge savings in the cost of labour. The determination of this cost saving is carried out as follows. Table 1 shows the average monthly wages of each category of employees in the company under study.

Table 1 Average Monthly Wages of the Categories of Employees

Categories	Average Monthly Wages
Topmost manager	67,580
Intermediate level	43,820
Supervisory level	19,336
Operations positions	17,784

For the existing organization structure, we have one (1) topmost manager, three (3) intermediate level managers, eight (8) supervisory level employees and 86 employees in the operations positions.

Table 2 Comparison of data

S/N	Items	Existing	Rationalised	Reduction
1	Executive Chairman*	1	0	1
2	Managing Director	1	1	0
3	Administrative Manager	1	1	0
4	Financial Manager	1	0	1
5	General Manager	1	1	0
6	Auditing Manager	1	1	0
7	Marketing Manager	1	1	0
8	Administrative Officer	1	1	0
9	Site Engineer	1	1	0
10	Plant Supervisor	1	1	0
11	Public Relation Officer	1	1	0
12	Field Officer	1	0	1
13	Road Supervisor	1	1	0
14	Administrative Clerk	1	1	0
15	Account Clerks	6	3	3
16	Secretaries	3	2	1
17	Typists	2	2	0
18	P.R.O. Assistant	2	1	1
19	Auditing Assistants	2	1	1
20	Auditing Clerks	3	1	2
21	Rakers	12	8	4
22	Mechanics	4	2	2
23	Labourers	15	9	6
24	Pay Loader Operators	2	2	0
25	Store Keepers	3	1	2
26	Cabin Operators	5	3	2
27	Burner Operators	5	3	2
28	Welders	2	1	1
29	Electricians	3	2	1
30	Cleaners	3	2	1
31	Gardeners	2	2	0
32	Drivers	10	6	4
33	Securities*	6	6	0
34	Operations Position	86	52	34
35	Topmost Manager	1	1	0
36	Intermediate Managers	3	2	1
37	Supervisory Positions	8	7	1
38	Decision Positions	12	11	1
39	Total Number of Staff	104	68	36
40	Personnel Utilization	0.4787	0.8065	0.3278
41	Annual Cost of Labour	₦22,665,024	₦14,646,480	₦8,018,544

* Job position excluded from the study.

Therefore, the total monthly wage (or cost of labour) of the existing structure

= ₦[(67,580 · 1) + (43,820 · 3) + (19,336 · 8) + (17,884 · 86)]
= 67,580 + 131,460 + 151,688 + 1,538,024 = ₦1,888,752

The annual wage of the staff in the company

= ₦1,888,752 · 12 = ₦22,665,024

Now, for the redesigned (or rationalized) structure, the total monthly wage

= ₦[(67,580 · 1) + (43,820 · 2) + (19,336 · 7) + (17,884 · 52)]
= ₦(67,580 +87,640 +135,352 + 929,968) = ₦1,220,540

The annual wage of staff in the redesigned structure

= ₦1,220,540 · 12 = ₦14,646,480

Monthly saving on cost of labour

= ₦(1,888,752 – 1,220,540) = ₦668,212

Annual saving on cost of labour

= ₦(22,665,024 – 14,646,480) = ₦8,018,544

Table 2 shows the comparison of data for the existing and the rationalized structure.

3. DISCUSSION OF RESULTS

The general results of data analysis shows that in the rationalized structure, the number of topmost manager is one and occupied by the Managing Director; while the number of both the intermediate level managers and supervisory positions have been reduced from 3 to 2 and 8 to 7 respectively. Also, the number of operations positions has been dramatically reduced from 86 to 52. It could also be observed that personnel utilization of the existing structure would be raised by 0.3278 (or 71.76%), while a huge saving of about N8.018 million that would be made from the cost of labour annually. The entire organization size would be reduced from 104 to 68 (or by 33.67%).

The number of hierarchical management levels was practically reduced from about six to four. The author could observe that the actual number of hierarchical management levels in the company could not be specified. Perhaps, due to the differences in wages, even for those employees assumed to be on the same level. That is, the more the differences in wages, the more the number of decision levels. This issue of differences in wages among employees has caused a large number of decision levels to indirectly exist. However, six decision levels have been identified in the existing structure (this is shown in Figure 1). However, it should be noticed that the values of human interaction dynamics at each level of management are the basis for which the number of staff at all the management levels were determined. Nasrallah and Levitt (2001) had suggested that an organization is most effective when it maximizes the interaction value, proportion of interaction time per person and the success probability. It could be observed that the parameters' values obtained in all the management levels are relatively low; and low values of μ, the superior attending rate at the management levels (especially at the supervisory level) means that the staff at the management levels, particularly those at the supervisory level do more than attending to their subordinates. They attend meetings on behalf of the establishment which may not be adequately covered during the study. It may also be that the tasks involved are complex. In the same vein, low values of λ, the subordinate consulting rate could be explained to mean that the subordinates are experienced or that the tasks involved (especially at the operations level), are simple. The relatively low value of N_0, the number of operations positions means that the volume of terminal activities is relatively low; thus, the dramatic reduction of the number of operations positions from 86 (in the existing structure) to 52 (in the rationalized structure).

This dramatic reduction in the value of N_0 coupled with the moderated number of supervisors will enable thorough supervision and effective execution of terminal activities, thereby causing a dramatic improvement in the personnel utilization factor from 0.4787 (in the existing structure) to 0.8065 (in the redesigned structure).

The position of the executive chairman as the topmost manager, is mainly that of politics and becomes irrelevant in this study. This position is observed to be unproductive and should be eliminated. As far as decision making is concerned in company's administration, the managing director becomes the only relevant topmost manager.

4. CONCLUSIONS

It was then concluded that a dramatic improvement in the personnel utilization factor and a huge savings on cost of labor were made with redesigned structure put in place.Therefore, with good management, few but adequate number of decision levels will check the problem of excessive delays, even in a bureaucracy. Moreover, adequate number of staff at the operations positions and at each decision level will ensure high personnel utilization and minimize cost of labor. The reduction of the number of decision levels and the number of staff in the entire organization was made possible by applying the principles of one-boss organization structure and equal workload for workers at the same level.

Application of quantitative techniques in organizational design can lead to improvement in manpower utilization and raise productivity level.

5. REFERENCES

[1] Galbraith, J. R.; Nathanson, D. A.: Strategy Implementation: The Role of Structure and Process, West Publishing, St. Paul Minnesota, 1978.

[2] Stewart, R.: The Reality of Organizations: A Guide for Managers, Macmillan, 1993.

[3] Burton, R. M.: The Future of Organization Design an Interpretative Synthesis in Three Themes, Journal of Organization Design, Vol. 2, No. 1 (2013) 42-44.

[4] Alberts, D. S.: Rethinking organizational design for complex endeavors, Journal of Organization Design, Vol. 1, No. 1 (2012) 14-17.

[5] Kulik, B. W.; Baker, T.: Putting the organization back into computational organization theory: a complex Perrowian model of organizational action, Computational and Mathematical Organizational Theory, Vol. 14, No. 2 (2008) 84-119.

[6] Drucker, P. F.: Management: Tasks, Responsibilities, Practice. Harper and Row, 1973.

[7] Vancil, R. F.: Decentralization Management Ambiguity by Design, Dew Jones-Irwin, Homewood, 1978.

[8] Hammer, M.; Champy, J.: Reengineering the Corporation: A Manifesto for Business Revolution, New York,. NY: Harper Business, 1993.

[9] Hax, C.; Majluf, N. S.: Organizational Design: a Survey and an Approach, Operations Research, Vol. 29, No. 3 (1981) 417-447.

[10] Charles-Owaba, O. E.: Organizational Design: A Quantitative Approach, Oputoru Books, Ibadan, 2002.

[11] Taha, H. A.: Operations Research: An Introduction, Macmillan, New York, 2007.

[12] Ismaila, S. O.; Akanbi, O. G.; Charles-Owaba, O.E.: Cost Minimization Approach to Manpower Planning in a Manufacturing Company, Pacific Journal Science and Technology, Vol. 10, No. 1 (2009) 191-196.

[13] Nickols, F. : The Span of Control and the Formulas of V. A. Graicunas, Distance Consulting, 2003. <http://www.nickols.us/graicunas.pdf>.(Accessed: 5.07 .2013.)

[14] Mackenzie, K.: Measuring a person's capacity for Interaction in a Problem Solving Group, Organizational Behavior and Human Performane, Vol. 12 (1974) 149-169.

[15] Nasrallah, W.; Levitt, R.: An Interaction value Perspective on Firms and Differing Size, Computational and Mathematical Organizational Theory, Vol. 7, (2001) 113-44.

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