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Target Output, Extended Output and Site Productivity: Tales of the Expected

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Abstract
Target output, extended output and moderate output are compared for selected construction projects in some selected sites in Nigeria. The objective of this study is to examine the attributes of extended and moderate output, setting of benchmarks for purpose of analysis of worker productivity, determination of derivable benefits, with a view to identifying if the effect are the same for both methods. The study procures the primary data used in this study through the use of questionnaires designed in Likert scale 1 to 5, which are sent to clients, builders and consultants. In all, 120 questionnaires were sent to these respondents who recently completed their housing projects based on the two methods. Results of the study indicate that there is significant difference between both methods in terms of risks of value for money, guaranteed sense of self accomplishment, while a significant difference exists between both methods in job burnt- out effect, timely completion of project, and exhaustion,
Moderate target output method demonstrates less risk of timely completion of project than the extended target output. This study concludes that there are various types of risks inherent in use of both methods in housing projects. The study displays characteristics of early completion of project and prospects of getting good value for money. Recommendations of the study are that clients, contractors and consultants should use Moderate target output for execution of their future housing projects job allocations, and also they are at liberty to use any of the two methods as they best satisfy their requirements. Implications of this study to policy makers and other stakeholders in the construction industry is that Moderate labour output method should be explored for use in large and complex projects as considerable cost savings can be achieved, timely delivery of project and good value for money are equally derivable benefits of the method. The outcome of this study serves as a watershed to other peculiar issues inn site productivity and job beats' allocations.
Keywords: Moderate Output, Extended Output, Productivity, Target

1.1INTRODUCTION

Productivity is regarded as one of the parameters often used to measure profitability of an average construction worker. Productivity is considered as output of a worker per hour within a specified range of output which is often rewarded based on the hour the work is carried out. Output of an average worker is relative when considered within the context of other workers; the output could be changed based on individual determination to increase his output consideration base on attached reward. Productivity is also regarded as the measure of effectiveness of a system at utilizing input. Therefore, in an output driven organization, productivity is a major concern and the effective conversion of resources into marketable outputs for profit on investment and productivity measurement is always a priority, (Wahab 2010; Wilcox; Stringfellow; Harris and Martin 2000).

However, methods used in output and productivity measurement differ from a site to the other. Some of usual practices include; allocating job in daily schedule basis, piece rate and contract method. In all cases, unit of measurement differs, based on construction activity therefore constitutes a major challenge in productivity measurement. Considering concrete placing activity, this operation is often measured in cubic meter and placement measures in man-hour per worker, whereas the steel reinforcement is measured in tonnes and linear meter per hour. This could be solved using relative values of productivity rather than absolute values of the output (Goodrum and Hana 2004).

Moreover in having a fair representative of the workers productivity, their schedules need to be appraised holistically taking scientific management insight into the output measurement; therefore, a benchmark in the form of target need to be established, having regard for moderate job allocation and extended job beats. This

would help in measuring the extremes. To this end, setting benchmarks within the context of productivity measurement, for purpose of scientific analysis of worker productivity with a view to identifying the effect on workers is a major preoccupation in this study.

1.1 UNDERSTANDING TARGET OUPUT, EXTENDED TARGET OUTPUT AND MODERATE TARGET OUTPUT

There are different forms of output in construction industry; target, extended and moderate target output. Target output refers to the output generated on account of an allocated task. This often refers to the daily allocated work and task often premised on an established unit rates. Sometimes, it is often scheduled on job card, this then forms basis for productivity measurement for the workers concerned. Extended output on the other hand refers to output measured through an extension to the normal daily job rate schedule of a worker (Harris and McCaffer 2005). It is often referred to as work overtime in another parlance; it is using more than eight (8) hours per day and 40 hours per week for more than two consecutive weeks. Extended overtime increases costs and reduces artisans' productivity. Furthermore, moderate target output could be described as the output situation whereby work is directly equal and proportional to the benchmarked standard work output. This could be explained as meant, output derived within normal stipulated rate for task accomplishment (Awad 2005, Hanna 2003).

1.2 REVIEW OF EXISTING WORKS: CONCEPT OF WORKERS PRODUCTIVITY

Productivity and output are sine qua none; they are regarded as process induced phenomena. However, considerable efforts have been expended in illustrating the concepts as related to construction site productivity through researches and studies. Site labour productivity was studied by Olomolaiye (1996), the study researched into the possibility of establishing output through motion study of the site activities, the study came up with benchmarked output figures through time study techniques. Similarly, Lim and Alum (1995) carried out a study on factors affecting productivity in construction industry in Singapore and came up with unmanaged target and moderate output, and communication problem among others. Chang; Neely., Haskel., Moeslein and Afraz (2005) classified factors influencing site productivity into three groups, while Olomolaiye et al; (1996); Kenneth (2005) opined that factors influencing construction output are connected with material prices and labour wages and can be categorized into external and internal factors. External factors include; the nature of industry, client construction experience, weather and economic condition while internal factors includes technology, labor and management. Finally, Flanagan; Cattell. and Jewell. (2005); Awad; Craig and Kenneth. (2005) described factors affecting construction productivity as technological and administrative factors. The study stated further that technological factors cover those that are related to the design of the project while administrative factors are those that relate to the management and execution of project work.

1.3.1 LINE OF PHILOSOPHICAL THOUGHTS IN CONSTRUCTION SITE PRODUCTIVITY

There are different lines of philosophical thoughts in construction output and productivity; namely Kern and Neil line of thoughts. Neil philosophy believes that productivity is influenced by a tripartite phenomenon; "know how to do," "want to do," and "allow to do a job" (Neil and Kern 1982). According to Neil and Kern 1982, management controls most of the constraints on all three axes; the "want to" factors include job content, interpersonal atmosphere, working condition, physical capability and society. The "know how to do" factors entails technological capability of workers acquired through training and development while "allow to do" factors revolves around creating good environment, good working condition, adequate tool, information and time to act. However, Neil school of thought advocates management operation benchmarks as panacea to eliminating anti-productivity vices on sites. It advocates elimination of non-productive time, provision of manual for construction procedures that are standardized for workers, better scheduling of work (Proverb and Holt 1998b;Rojas and Aramvareekul 2003; Yap 2006))

Neil and Kern (1982) further advocated low craftsmen morale and inefficiency as factors that induce low output and productivity while extended output can be induced by complex designs, strikes and procurement delays among other factors (Lath 2010; Crawford and Vogi 2006). The combination of submissions from Neil and Kern line of philosophical thought need to be researched and validated further so as to establish factors that induces low output and hinders productivity as has been done in this study.

1.3 RESEARCH METHODS

Literature review was conducted for the purpose of identifying target output and site productivity variables for this study. This forms the basis of designing four sets of questionnaires for the site workers, site managers and contractors who constituted the population of the study as to elicit the primary data from these respondents. Respondents must have just completed recent projects. Systematic sampling technique was used in sample selection. Some recently completed projects were compiled and selected using the systematic sampling approach generated 65 residential building projects and 60 office building projects. In all, 125 questionnaires were sent to various site workers, site managers and contractors who participated in these projects. 68 workable responses were obtained

1.4 FINDINGS AND DISCUSSIONS

Table 1 presents schedule of company rate, daily job allocation (target output) and corresponding overtime where applicable. Target output is described as the amount of work allocated to a worker according to individual trade. Four (4) different trades were sampled for their output, these includes: masonry, carpentry, tilling, steel bending among others. Benchmarked company rates, allocated work quantity (target output), quantity of work done, quantity of work done as overtime. Daily task allocation for block work and plastering according to the respondent is 100 to 130 blocks with 2 to 3 m^2 done as overtime in excess of daily job allocations. In tiling operation $30m^2$ was indicated as target output while workers ends up with 2-$3m^2$ extended output. Extended overtime varies for other trades such as carpentry steel work and concrete work.

Table 2 displays instigators of extended target output (ETO),80% subscribed to rework on account of turn down job and health issues as factors that can induce extended target output; 75 % indicates lack of appropriate tools, force majeure as some of the factors; 70 % indicates change order and site disputes; 60-62% indicates lack of materials and interference while 25-30% suggested delay in inspection and work rejection by consultant as some of the factors that can instigate extended work output. Implication of the results above is that, lack of necessary tools, change order and request for rework are highly favored as being responsible for extended work allocation in excess of daily allocation. Therefore if those factors could be taken into consideration at planning stage, the effect of extended target allocation would be eliminated.

Table 3 presents psychological effects of extended target output (ETO) on workers. Impact effect index was calculated for all psychological implication of extended target output. Job burnt out among the listed impacts has highest mean impact index (MII) of 0.9, closely followed by exhaustion with 0.88 mean index, tiredness has 0.85, depression was scored 0.6 while loss of focus and loss of concentration were scored with MII values of 0.53 and 0.65 respectively. Reasons for these results could be that when the output expected to be turn up by a worker is changed, extra effort would be needed to get the work done thereby straining the work to their capacity, in such situation, job burnt out could be inevitable and other associated challenges like tiredness, fatigue, exhaustion loss of concentration among others.

Table 4 illustrates social-economic impact of extended target output on workers, poor job quality was rated highest on mean social-economic index (MSEI) of 0.92 and 88%, increased job accident was rated high on 87 % with mean social-economic index of 0.85; decrease in job quality has 82% with MSEI value 0.84; while increased incidence of return job scored 68% with MSEI value of 0.65. These results infers that the most recognized social–economic impact of extended target output is poor job quality, increased job accidents and decreased job quality. Productivity tend to decrease when a worker wit has been over extended, thus the workers would no longer be at their best thus turning up poor quality jobs and this tend to lead to rework and rejected products.

Table 5 presents effects of moderate target output on site workers, the most subscribed factor are improved workers' morale (MSEI value 0.94 and 82%), job burnt-out reduction (MSEI value 0.92, 80%) and on-job accident reduction (0.90 MSEI value and 75%). Other effects includes sense of self accomplishment (0.79 MSEI value and 76%), high quality job output (0.82 MSEI value and 70%) and reduction in human and equipment breakdown (0.75 MSEI value and 65%). The results indicate among other things, that when production target is set moderately, it induces beneficial influences, such as demonstrated in the research outcome, this explains reason behind the choice of improved workers morale, reduction in job burnt-out effect and reduction in human, high quality job output and equipment breakdown among others as some of the benefits of setting moderate production output target.

Table 7 contains summary of Chi square test results for comparison of risk involved in extended target output and moderate target output. The calculated Chi-square values (X^2 cal=3.45,0.00, 1.02) are lower than tabulated value X^2 tab=3.97) for risk of not obtaining value for wages

paid to the workers, risk of obtaining satisfaction for work quality, evolution of more claims and variation to original work allocation schedule, hence the results are not significant. They are all pro-null hypothesis. It can hence be inferred that there is no significant difference between extended target output and moderate target output when risk of not obtaining value for wages paid to the workers, risk of obtaining satisfaction for work quality, evolution of more claims and variation to original work allocation schedule are of the essence. While for risk of timely completion of job allocation the calculated chi-square value (X^2cal =8.75) is higher than the tabulated value (X^2tab=3.57) hence the result is significant. This implies accepting the alternative hypothesis. This also means that a significant difference exists between extended target output and moderate target output in terms of risk of untimely completion of allocated job beats. This also suggests that moderate target output is less risky than extended production target output when completion time for allocated task schedule is of high priority. Table 9 presents inferential results for comparisons of prospects of both extended target output and moderate target output (X^2-cal = 0.00, 25.35, 1.38 and 10.11) value is lower than the tabulated value (X^2 tab =3.92, 34.54, 32.55 and 33.67) hence the results are not significant they all support the null hypothesis. Therefore null hypothesis is accepted. Implication of this is that there is no significant difference between extended target output and moderate target output when prospects of improved workers morale, job accident reduction, elimination of job burnt out effect and breakdown prevention are of the importance. Also, from the results, prospect of guaranteed sense of self accomplishment has calculated chi-square value (X^2 cal = 39.21) higher than the tabulated value (X^2 tab=30.36) hence the result is significant. This implies accepting the alternative hypothesis. This also infers that a significant difference exists between extended target output and moderate target output when prospect of guaranteed sense of self accomplishment of value for money is of the importance. Generally, moderate target output has good results and preferred than extended target output approach.

1.5 CONCLUSION AND RECOMMENDATION

With regard to the finding above, the study concludes as follows: Extended Target Output and Moderate Target Output were examined for risk attributes. Moderate target output demonstrates less risk tendency in term of obtaining satisfaction from quality of work produced than extended target output. There are also derivable benefits accruable from the moderate target output and extended target output. Guaranteed sense of self accomplishment is regarded as the highly rated derivable benefits of moderate target output, while improved workers morale is adjudged the best derivable benefit of extended target output. The study recommend moderate target output for the use of client, builders and consultants, since the method guaranteed timely completion of job beats. This study has established that moderate target output improved workers morale and reduces job burnt out among other factors while one of the effects of extended target output is exhaustion. Clients, builders and professional are advised to use any of the methods while careful consideration should be given to the negative effect it can create on workers, and select the one that best satisfy their requirements. Application of this study in policy making in government, also private and public clients, for small and complex projects output is recommend for method of output benchmarking and formulation. Clients, builders would find the study valuable when it comes to issue of appraisal of productivity driver mechanism. However, with the adoption of moderate target output, projects can be completed on time while client obtains good value for money invested in the project. This research can serve as a launching base for further research in application of moderate target output in construction project work job allocations.

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List of Tables

Table 1 Daily Target Output and Work Overtime

S/N	Trade	Company Rate	Daily Work Allocation	Amount Done Overtime
I	Masonry			
A	Blockwork	₦400/m^2	8m^2 - 30m^2	20/3m^2
B	Plastering	₦(300-350)/m^2	20m^2	2m^2
Ii	Carpentry			
A	Roof Covering	₦250/m^2	Contract Based	---
B	Doors and Window Frame	₦400/Nos	5 Nos	1-2 Nos
C	Formwork for Concrete Works	₦300/m^2	Varies	Varies
D	Roof Carcass	₦50/m	Linear meter	Varies
Iii	Tilling			
A	Floor Tiles	₦320/m^2	₦30m^2	2m^2 - 3m^2
B	Wall Tiles	₦350/m^2	₦30m^2	2m^2 - 3m^2
C	Steel Work			
D	Reinforcement	₦19/m^2	1.3 Tonne	Varies

Table 2 Instigators of Extended Output

S/N	Instigators Variables	Respondent Percentage	Mean Index Score
I	Rework	80	0.89
Ii		75	0.85
Iii		60	0.65
Iv		62	0.66
V		55	0.52
Vi		25	0.30
Vii		41	0.40
Viii		70	0.69
Ix		80	0.82
X		75	0.87
Xi		30	0.45
		70	0.75

Table 3 Psychological Effects of Extended Output on Workers Productivity

S/N	Psychological Effect Variables	Respondent Percentage	Mean Index Score
I	Exhaustion	80	0.85
Ii	Depression	32	0.60
Iii	Tiredness	79	0.80
Iv	Loss of Concentration	40	0.65
V	Loss of focus	60	0.53
Vi	Job burnt-out	85	0.90

Table 4 Social Effects of Extended Output on Workers Productivity

S/N	Social Effect Variables	Respondent Percentage	Mean Index Score
I	Increased Job Accident	0.87	0.85
Ii	Poor Job Quality	0.88	0.92
Iii	Decrease in Product Patronage	55	0.50
Iv	Increased Incidence of Returned Job	68	0.65
V	Decrease in Job Quality	83	0.84
Vi	Labour Unrest	39	0.35
Vii	Decrease Productivity	48	0.45

Table 5 Effects of Extended Output on Workers Productivity

S/N	Effect of Extended Output	Respondent Percentage	Mean Index Score
I	Improved Workers Morale	82	0.94
Ii	Job Accident Reduction	75	0.90
Iii	Good Quality Job Output	70	0.82
Iv	Sense of Self Accomplishment	79	0.79
V	Breakdown Prevention	65	0.75
Vi	Reduced Job Burnt-out	80	0.92

Table 6 Descriptive Results for Comparisons of Extended Target Output(ETO) and Moderate Target Output(MTO)

S/N	Comparism Variables	ETO	Yes	No	MTO	Yes	No
I	Risk of Value for Wages paid to Workers	35	65	35	35	36	64
Ii	Risk of not Satisfying with Job quality	35	65	35	35	40	60
Iii	Risk of delay in Job completion	35	60	40	35	18	82
Iv	Evolution of more Claims	35	60	40	35	22	78
V	Variation to Original Work allocation Schedule	35	82	18	35	10	90

Legend: Extended Target Output(ETO) Moderate Target Output(MTO)

Table 7 Chi-Square Test Results for Comparisons of Extended Target Output and Moderate Target Output

S/N	Comparison Variables	X^2-cal	X^2-tab	Sig	Decision
I	Risk of Value for Wages paid to Workers	3.45	3.92	NS	Accept H_0
Ii	Risk of not Satisfying with Job quality	0.00	3.57	NS	Accept H_0
Iii	Risk of delay in Job completion	8.75	3.57	S^*	Reject H_0
Iv	Evolution of more Claims	0.00	3.57	NS	Accept H_0
V	Variation to Original Work allocation Schedule	1.02	3.57	NS	Accept H_0

Table 8 Descriptive Results of Derivable Benefits in Extended and Moderate Target Output

S/N	Derivable Benefits Variables	Moderate Target Output	Rank	Extended Target Output	Rank
I	Improved Workers Morale	0.85	2	0.58	1
Iii	Job Accident Reduction	0.75	4	0.3	5
Iii	Guaranteed Sense of Self Accomplishment	0.88	1	0.55	2
Iv	Elimination of Job-burnt out	0.76	3	0.38	4
V	Breakdown Prevention	0.67	5	0.52	3

Table 9 Chi-Square Test Results for Comparisons of Derivable Benefits in Extended and Moderate Target Output

S/N	Comparison Variables	X^2-cal	X^2-tab	Sig	Decision
I	Risk of Value for Wages paid to Workers	0.00	3.92	NS	Accept H_0
Ii	Risk of not Satisfying with Job quality	25.35	34.54	S^*	Reject H_0
Iii	There is risk of delay in Job completion	39.21	30.36	NS	Reject H_0
Iv	Evolution of more Claims	21.38	32.55	NS	Accept H_0
V	Variation to Original Work allocation Schedule	10.11	33.67	NS	Accept H_0