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An Investigation into the Use of Work Study Techniques in Nigerian Manufacturing Organizations

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Abstract: The study was designed to investigate the use of work study techniques in major manufacturing industries in Nigeria. A stratified random sampling was done using seventy-three quoted companies from the major industrial zones in Nigeria. Questionnaire and interview techniques were used for collecting data for this study. Appropriate statistics were employed in the data analysis. It was found that majority of the manufacturing organizations know about work study techniques in their engineering and production activities as well as productivity improvement programme. The result of the survey revealed that a majority of the companies were not interested in the use of work study techniques due primarily to the lack of expertise knowledge, lack of necessary facilities, many engineering hours and substantial financial resources it requires. Necessary recommendations that must improve the use of the principles and tools of work study and enhance productivity of ventures are suggested.

Key words: Work study, method study, investigation, work measurement standards,organizations

INTRODUCTION

Work study is an important tool in productivity improvement in industrial organizations, especially if the company wants to survive and cope with present day market competitions and inflation (Anyanwu, 1985). Work study is a generic term for those techniques particularly 'Method Study' and 'Work Measurement' which are used in examination of human work in all its contexts and which lead systematically to the investigation of all the factors which affect the efficiency of the situation being reviewed, in order to seek improvements (ILO, 1981). Method study ensures effective operations and utilizations of inputs while work measurement ensures their efficiency. Method study is a general term, which covers a host of techniques for reducing the amount of work content of a job. Work measurement techniques generally are applied to establish the standard time for a qualified worker to do one unit of job at defined level of performance. For a company to remain competitive and profitable, it must continue to improve its methods of production or services.

Work study techniques can be used to improve work methods and to set time standards. The use of the principles and tools of method study can enhance method improvement. The benefits to be derived include reduced costs, higher yields and greater utilization of resources, less scrap, job satisfaction and improved quality. Apart from method study, work measurement is an important and useful engineering management tool. Once developed, standards provide the basis for determining manpower requirements, ascertaining and controlling costs, comparing and evaluating the performance of employees, supervisors or work centres and improving operating methods and procedures (ILO, 1981). Work standards are the declarations of the amount of time that should reasonably be used to perform a specified activity at a sustainable rate, using established methods under normal working conditions. Methods used to set job standards include historical estimates from experience, time study, predetermined time standards and work sampling. Job standards provide data that are basic to many decision-making problems in production.

Work measurement provides information that could be utilized by management in planning, organizing, staffing and controlling. Also, it provides a basis for appraising actual result, initiating corrective action and organization activities in such a manner that the most efficient and effective combination of men, machine, material and information is achieved (Donald, 1970). The bottom line of these benefits is improved productivity.

A survey conducted in 1986 in Japan, Europe and the United States revealed that the productivity of companies using work measurement techniques was higher than companies not using them (Singeyasu, 1987). According to the survey, 83% of Japanese companies and 92% of European and American companies have set specific time standards and consider them a valuable tool. Japan tends to use more informal work measurement techniques, such as estimation by experience and measurement from historical business results.

In a developing country like Nigeria, few analyses on production methods and setting of time standards have been carried out using work study techniques. The only two reported in the literature are the work of Anyanwu (1985) who applied work study to improve productivity in A.C. Cristlied Plc. in Lagos and Mohammed and Aderoba (2000) who carried out analysis of production processes of traditional weaving loom as well as establishing time standards on which subsequent mechanization would be based.

Within this period of depressed economy where scarcity of raw materials is making many companies to fold up, it has become more necessary than ever to establish precisely what quality of material "X" should produce product "B" which will conversely assist management to monitor material usage and wastages. Since material constitutes at least 40-60% of total cost of production nowadays (Anyanwu, 1985). The present practice whereby this important function is left on the hands of production managers, quality control managers and others at the exclusion of industrial and production engineers must be reversed.

This study was therefore, designed to determine extent of knowledge as well as the possibility of previous application and use of work study techniques in Nigerian manufacturing organizations.

MATERIALS AND METHODS

Aboyade (1968) grouped the industrial centres of Nigeria into what he termed "the great industrial zones of Nigeria". These are the Lagos/Greater Lagos zone, the Port Harcourt zone, the Kaduna/Zaria zone and the Warri/Sapele zone. This grouping was used for this study because of the researchers desire to choose an industrial zone with a high concentration of manufacturing organization that were listed on the stock exchange. Seventy three of the ninety seven industrial manufacturing organizations that were listed were randomly selected. The sample size represents about 75% of the population. This is to improve findings in terms of precision.

Data were collected with the use of questionnaires administered on 300 staff that was directly involved in the selected organizations' work study application. Also, interviews were carried out where it was considered necessary. Analyses were carried out using percentages, average means and standard deviation. The companies operated in different lines of business: Breweries, building materials, automobiles and tyres, chemical and paints, soap and toiletries, food/beverages and tobacco, footwear, industrial/domestic products, packaging, pharmaceutical and animal feed and textiles.

The questions which relate to work study activities include:

- Knowledge of study techniques
- Previous use of work study techniques
- Interest in the use of work study techniques
- Types of method study techniques employed
- Types of work measurement techniques used
- Factors affecting the choice of work measurements techniques
- Development and computerization of work measurement standards
- Application areas where work measurement standards are used
- Factors affecting productivity in manufacturing organizations.

RESULTS AND DISCUSSION

The results obtained from the study were analyzed below to determine knowledge of work study techniques, previous use and interest in the use of work study techniques, types of work study techniques employed, development and computerization of work measurement standards, application areas where work measurement standards are used, application of work measurement standards and factors that affect productivity of manufacturing organizations.

From Table 1, it is obvious that majority of the executives in Nigerian manufacturing companies already know about work study techniques in productivity improvement programme. The subjects were further asked to list the types of work study techniques they were familiar with. The host listed operation (outline) process chart, flow process chart, flow diagram, string diagram, multiple activity chart, two handed process chart, historical records, estimating, factored estimating, comparative estimating, analytical estimating, work sampling, Predetermined Motion-Times System (PMTS), time study, Method-Time Measurement (MTM).

The data in Table 2 show that 26% of the subjects had previously used work study techniques in their

Table 1: Knowledge of work study techniques by nigerian manufacturing industries' top executives

Categories	(%)
Previous knowledge of work study techniques	75
No previous knowledge of work study techniques	25

Source: Field survey, 2001

Table 2: Previous use of work study techniques

Categories	(%)
Previously used work study techniques	26
Not previously used work study techniques	74

Source: Field survey, 2001

Table 3: Interest in the of work study techniques

Categories	(%)
Interest in the of work study techniques	27
No interest in the of work study techniques	73

Source: Field survey, 2001

Table 4: Types of method study techniques employed

Types of method study techniques	(%)
Operation (Outline) process chart	26
Flow process chart	13
Two handed process chart	6
Multiple activity chart	5
Flow diagram	20
String diagram	2
Chronocyclegragh	0
S.I.M.O. (Simultaneous-Motion-Cycle)	0
Models	5

Source: Field survey, 2001

Table 5: Types of work measurement techniques employed

Types of work measurement techniques	(%)
Historical records	5
Estimating	22
Factored estimating	10
Comparative estimating	20
Analytical estimating	20
Work sampling	25
Time study	26
Pre-determined Motion-Times System (PMTS)	0

Source: Field survey, 2001

Table 6: The factors affecting the choice of work measurement techniques

Factors	Responses
Types of work being measured	19
Objectives of the work measurement programme	24
Management policy	26
Availability of funds for the programme	16

Source: Field survey, 2001

companies while 74% had not. The respondents were asked to indicate their reasons for using work study techniques and the commonest reason given by them was the fact that each technique helps them to reduce cost and so improve productivity in the long run.

Data in Table 3 show that majority of the manufacturing organization were not interest in the use of work study techniques. The subjects were asked why they would not like to use work study techniques. They gave reasons such as lack of expert knowledge, lack of necessary facilities, many engineering hours and substantial financial resources necessary for establishing the programme and operating it effectively on a continual basis, hostile and lukewarm attitude towards work study programme on the part of factory personnel and top management respectively. Managements were concerned that setting standards now would further damage performance.

Table 4 is an indication that many organizations do not carry out or cover methods analysis and improvement. Some of the firms that carried out work study seem to be caught in a dilemma regarding the extent of methods analysis. Consequently, each firm is forced with the problem of weighing the need for detailed methods.

Survey (Table 5) indicates that some of the manufacturing organizations use more than one technique. The techniques are used in combination, as crosschecks. The most used techniques were work sampling, time study, as a combination.

Factors affecting the choice of work measurement techniques: There exists a general relationship between the work being measured and the best technique for measuring. A routine inspection of raw material or work-in-process is best accomplished through the use of predetermined times or stopwatch time study, whereas non repetitive or non standardized production activity such as maintenance is probably best measured through the use of work sampling. The objectives established for the work measurement program have a considerable bearing upon the selection and use of techniques. If imprecise techniques are used where great accuracy is required, the results will be less than satisfactory. If overly precise techniques are used where precision is not required, the cost and time of developing standards may exceed the value of the standards. Thus techniques should be selected in the light of the objectives to be achieved. Guidelines established by top management often limit the choice of work measurement techniques. The reluctance of the organizations to commit large amounts of financial resources to the programme imposes a constraint upon technique selection, limiting the choice of techniques to those involving minimal training and implementation costs, in other words to historical records. The factors affecting the choice of work measurement techniques as perceived by the respondents are shown in Table 6.

The indication is that few of the manufacturing organizations that employed work measurement techniques agreed that management policy is the most important factor that determined the choice of work measurement techniques employed. Followed in descending order of the four factors are objectives of the work measurement programme; types of work being measured and availability of funds for the programme.

Development and computerization of Work Measurement Standards (WMS): Work measurement is a generic term referring to the use of ay systematic technique for converting a qualitative statement of the workload to a quantitative statement of the required time use of resources such as machine, human endeavours or robot (Donald, 1970). The resulting coefficient from any of the work measurement technique is called standard time, job standard or work measurement standard.

Table 7: Questions and responses on development and computerization of work measurement standards

Summary of the questionnaire	Responses (%) Yes	No
Does your company develop and utilize work measurement standard?	26	74
Is management itself accountable for work measurement standard?	26	74
Do all the company's employees understand the work measurement standards?	10	90
Does your company employ training scheme?	44	56
Does your company employ performance scheme?	28	72
Does your company have in effect a systematic and objective compensation plan with clearly stated work measurement standards as the basis for salary increases?	28	72
Does your company computerize its application of work study techniques?	10	90
Would company executives prefer to employ Industrial/production engineers that were trained in applied work study with software package?	27	73

Source: Field survey 2001

Table 8: Application areas of work standards

Application areas	(%)
Capacity determination	13
Manning levels	25
Productivity ratios	13
Machine loading	12
Performance measurements	18
Productivity measurements	19
Incentive schemes	21
Line balancing	8
Determination of labour cost	16
Determination of production cost	15
Maintenance planning	20
Machine efficiency measurement	7
Balancing of operator/machine operation	6
Programming of production in terms of labour, plant and material	5
Scheduling of production	17
Process planning	4
Standard costing	10
Product costing	22
Budgeting and budgetary control	9
Material usage variance analysis	3
Labour cost variance	12
Estimating of cost	23
Manpower planning	26

Source: Field survey, 2001

Table 9: Distribution of rating of factors affecting productivity in manufacturing organizations

Factors	Means rating	Standard rating score
Quality of work life	3.70	0.46
Production volume	2.41	0.69
Human resources	3.53	0.51
Machinery and equipment	3.31	0.78
Government regulation	2.92	0.71
Resource scarcity e.g. energy, metal, water etc.	3.00	0.77
Product (or System) design	2.62	0.49
Innovation and technology	2.92	0.83
Capital/labour ratio	3.42	0.49
Regulatory and bargaining effects	2.83	1.34

Source: Field survey, 2001

From Table 7, majority of the respondents confirmed that their organizations neither developed nor utilize WMS. This category represents 74% while the remaining 26% confirmed otherwise. Again 74% confirmed that management is not accountable for WMS while 26% confirmed otherwise.

On whether all the company's employees understand the work measurement standards, only 10% responded in the affirmative, the remaining 90% respond negatively. Fifty six percent of respondent companies employ training scheme while the remaining 44% do not employ it. 28% employ performance scheme while 72% do not employ it. When asked whether each of the company has in effect a systematic and objective compensation plan, a computerized application system or if the company would prefer to employ trained industrial/production engineers in applying work, The response with respect to the above questions were 26, 26 and 20% positive and 74, 74 and 80% negative response, respectively. The indication is that very few Nigeria organizations employ the use of WMS and hold management answerable for its shortcomings perhaps due to ineffective application. At the same time, employee orientation of WMS is too poor. Periodic retraining session ensures a continuously proficient level of application, a basic while understanding of rating makes it easier to make use of performance rating. In essence, work measurement procedure must be communicated to those people within the organization who will be expected to adhere to the procedures. Where the company does not have in place a systematic and objective compensation plan with clearly stated WMS as the basis for salary increases, workers become less motivated to attain standards, hence there exists a lowered morale among workers. Many of the firms understudied were yet to computerize their application; the indication is that scientific techniques are not widely used.

Application areas where work measurement standards are used: Work measurement standards satisfy the needs of worker, provide a measure of performance for the organization and facilitate production activities, engineering activities, production planning and control, personnel management and costing operations. The areas where various methods are being used are shown in Table 8.

For the companies that made use of work measurement standards, manpower planning is the heaviest use of job standards followed manning levels, estimating of cost, product costing, incentive schemes, line balancing, maintenance planning, scheduling of production, performance measurement and productivity

measurement. Process planning and material usage variance analysis were two areas making the least use of job standards. As the survey made clear, this traditional management technique is by no means "dead" or "outdated" in industry; rather it is apparently quite useful.

Factors affecting productivity in nigerian manufacturing organizations: The following 10 factors were isolated for study:

- Quality of work life
- Production volume
- Human resources
- Machinery and equipment
- Government regulation
- Resource scarcity e.g., energy, metals and water etc.
- Product (or system) design
- Innovation and technology
- Capital/labour ratio
- Regulatory and bargaining effects

The respondents were required to respond as "very high", "high", "medium", "low", "very low" with the corresponding rating score of 5,4,3,2,1, to these factors that affect productivity of manufacturing organizations in order of severity. The analysis of these ratings show that quality of work life has the highest mean rating while the production volume is rated the least (Table 9). The factors whose mean ratings fell within the high-medium severity bracket were human resources, machinery and equipment, government regulation, resource scarcity, product (or system design), innovation and technology, capital/ labour ratio. All 10 factors are rated as having some negative effect on productivity. Even production volume was considered to have negative influence on the intensity and the attention given to productivity improvement. Table 9 also revealed that there was strongest agreement amongst the companies that quality of work life make the most effect on productivity with the least standard deviation in their ratings. The companies were also fairly consistent in their rating of the production volume as the least factor that affects productivity (S.D = 0.69).

Quality of work life is perhaps the most encompassing reason for it reflects the entire work environment. The work environment directly or indirectly affects the workers' ability to do a job. A primary factor with the direct effects is the quality of the equipment made available to the workers. Secondary factors directly affecting job performance are light, heat and noise. The indirect factors include picnics, social club and athletics to instill a shared organizational mission in each of its employees. This has been a successful practice in the Japanese industries.

Training for work measurement should not be limited to technical training but also should include instruction in how to work with and through people. Many work measurement programme that were less than technically adequate have enjoyed singular success because the importance of good human resources was recognized. A declining capital/labour ratio reflects the fact that many of the plants and much of the equipment in the Nigerian Manufacturing organizations is over 25 years old.

The decreased level of capital investment signals a short term perspective that is characteristic of many firms. The major factor in long range continuing productivity improvement is technology and new technology depends on research and development, (R and D). For industries to put new technology into use, they must invest in new machinery and equipment. Manufacturing organizations do not maintain locally based R andD activities. Resources are increasingly scarce, especially energy, metals and water. Emphasis is shifting toward the use of renewable resources. Much as the equipment used in industries are imported, the same way spare parts are equally imported regularly which can be manufactured locally. The Nigerian machine Tools and Oshogo Steel Rolling Mill could take the lead on this.

An excessive amount of government regulation may have a detrimental effect on productivity. A reduction in R&D expenditure explains some of the decline in productivity, as does the deluge of regulations in the 1980s. The power of organized labour to command wage increases in excess of output increases has also had a detrimental impact. Value analysis can bring out many product design changes that improve productivity. In terms of production volume, if the level of output is to be doubled, the number of direct workers may be doubled and a few indirect workers added. This of course does not necessarily create the need for more engineers, research scientists, headquarters staff or other support personnel.

CONCLUSION

The present study revealed that work study techniques are indispensable to the manufacturing organization; work study techniques should be a ready tool in the hands of adept factory personnel because a lot

of importance has been attributed to these techniques. They increase the effectiveness of manufacturing organizations and subsequent improvement in the level of goal achievement in organizations. They ensure effective and efficient operation and utilizations of inputs. The establishment of priorities has been one of their main objectives.

The factory personnel should therefore adopt these techniques to avoid being activities trapped; hence the effort will be directed to the accomplishment of the goal of the manufacturing organization.

Implications to industrial management/management of engineering system:

- The knowledge of the use of work study techniques enhances productivity improvement.
- Ideas and strategies observed in the study could constitute a source of knowledge and facts to factory personnel in manufacturing system.
- Work study enhances prudent use of resources.
- Method study enhances method improvement.
- Work measurement provides the basis for production planning and control, engineering and most other industrial activities.

The implication of these findings would seem to be that with the knowledge of the use of work study technique, productivity improvement would be enhanced. Work study techniques are meant to increase the effectiveness of productive system and subsequent improvement in the level of goal achievement in manufacturing organizations.

RECOMMENDATIONS

These recommendations are therefore, made to encourage the use of these techniques and to enhance productivity in manufacturing industries.

- The factor personnel should be equipped with knowledge and facts on work study techniques.
- Seminars/workshop/in-service training should be organized for factory personnel on the usefulness and relevance of these techniques in the manufacturing system.
- As our industries' production planning and control departments get larger and more complex, they should have recourse to the application of the necessary expertise in work study techniques. Hence, manufacturing companies should use work study techniques as a strategy for building and sustaining competitive advantage. A company possesses competitive advantage when its profit is above the average for its industry.
- Careful management planning should be adopted in order to gain the full benefits from work study. Work study orientation must be accomplished on a continuing basis in order to be effective. Orientation on a continuing basis serves to indicate top management's ongoing support of and interest in the work study programme.
- Management must commit requisite amount of interest and enthusiasm not only at the start of the programme, but also through the life of the programme.
- Management must be willing to devote considerable time and energy to the initial efforts to plan and to implement the work study programme.
- Management should monitor the progress made, evaluate the results achieved and restructure objectives as conditions change and interprete/ formulate policies as necessary throughout the life of the programme.
- Analysis of production methods and setting of time standards should be done by industrial/production engineers who have the expertise knowledge in work study, operations research, behavioural sciences, systems analyst, the use of computerized management information systems, etc.
- Work measurement standards should be used as the basis of payment for the hourly wage in manufacturing organizations; as a result, they may be a source of contention in labour-management relations.
- Factory personnel/operators should be given opportunity to render advice on possible solution to the problem encountered in the plants.
- Factory personnel should be made aware of the benefits to be derived, if the company should achieve high productivity.
- Companies should improve the reward system and favourable working environment to reverse the incessant exodus of skilled and experienced manpower from the manufacturing organizations.
- Manufacturing companies should invest heavily in the modernization of their factories.
- Proper maintenance should be carried out on plant and machinery in order to operate properly and to prolong its life, so reducing capacity expenditure.

- Further study could be carried out to apply work study techniques in analyzing production method and setting time standards in our local manufacturing organizations in order to improve performance, efficiency, productivity and profitability.

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