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The Rate of Diffusion and Use of Information and Communication Technology (ICT) in Selected Manufacturing Industries in Ibadan, Oyo State, Nigeria

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Abstract:
The study examines the adoption and use of information and communications technology (ICT) in selected manufacturing industries in Nigeria. 26.5 per cent of the total population of the workers which is 336 out of 1268 responded to the questionnaire survey in the selected manufacturing firms. The ICT facilities used stratified the manufacturing companies in Nigeria into two major categories: ICT intensive users (SBC and FCD) and Non-ICT intensive users (APL and NML), this is the category most companies in Nigeria belong to. The results reveal that ICT facilities in the manufacturing firms are basically for administrative use rather than production and the use of ICT facilities to aid direct production activities is a generally low level among manufacturing industries in the country. However, some problems of ICT use were identified which undermined efficient and optimal use of ICT facilities.

Key words *Adoption, use, ICT, Manufacturing industry, performance and productivity*

1.**Introduction**

The continuous development of technology from a simple stage to a complex one, for example, the Information and Communications Technology (ICT) in organizations or industries is to make work simpler for man and to increase production and efficiency (Hall, 1977). Existing literature continues to present the manufacturing sector as a major one in the society that contributes immensely to economic growth and development. The manufacturing sector contributed 32.8% to Gross Domestic Product (GDP) in 2001 in Thailand. In Nigeria, the period of colonial diarchy after political independence promoted local industrialization. It was this era that the manufacturing sector contributed to the Gross Domestic Product (GDP) N7 million – N236 million which is between 0.5 per cent to 12 per cent. (Ekekwe, 1986). This sector will continue to assume a dominant role in the economic growth of the nation (Jason, 2002).

The manufacturing sector has a focus, while each organization is directed towards some end, or *some organizational goals*. A goal is a future expectation. It is something the organization is striving to accomplish. The goals of an organization will determine the nature of its outputs and the series of activities through which those outputs are achieved (Mullins, 1999). The successful achievement of an organizational goal depends strictly on workers' performance.

There is a great need for employers to organize and harness the skill and creativity of their workforce effectively if they are to succeed and meet the demands of international competitiveness. The challenge is to secure high levels of productivity and commitment to meet rapidly changing businesses, regulatory and technological circumstances, while meeting employees' needs for fulfilling, creative and supportive working environments. All these must happen in a tightening labour market that places a premium on skill.

In his own contribution on workers' performance in the manufacturing sector, Reilly (2003), noted that the introduction of e-business and the electronic mediation of customer relationship are now high on the agenda of both public and private sector organizations. It is raising the challenges of work vacation and organization, knowledge management, and skills obsolescence. As a result of these and other shifts in organizational strategy, employers are seeking greater workers' performance and productivity improvement from their employees.

For the manufacturing sector to play a crucial role in economic growth of a country, workers' performance must improve by maximizing the advantages of the emerging information technologies (Stephen, 2001). Camilla (2002) maintained that the Information and Communications Technology (ICT) sector zeroes in on carrying out many different activities, which make companies realize their set goals. The Organization for Economic Cooperation and Development (OECD) in 1998 agreed on the definition of the ICT sector for statistical purposes, based on the following two principles-

- that for manufacturing industries to be part of ICT sector it must intend to fulfill the function of information processing and communication including transmission and display, and it must use electronic processing to detect, measure and / or record physical phenomenon or to control a physical process; and
- that for service industries to be part of ICT sector, the products of an industry must enable the function of information processing and communication by electronic means.(Camilla Galli da Bino, 2002).

Moreover, the importance of ICT especially in the manufacturing sector cannot be over-emphasized owing to the pressure of globalization, consolidation, deregulation and rapidly changing technology (Woherem, 2001). For the manufacturing sector to properly place itself in a favourable position for competition and to be reckoned with in the new century, ICT must occupy the topmost issue in the company's agenda. Some manufacturing industries are now embarking on ICT investment, and ensuring that their personal computer per capital use by staff form local and wide networks.

The application and diffusion of ICT has produced growing manufacturing industry. The global IT market is currently estimated at a cost of 1.3 trillion US dollar. Shyamal and Susanne (2003) projected that global business searching for improved efficiencies, competitive advantages, and solutions to meet the emerging needs of new local and global markets would spend more than 2 trillion US dollar on IT by the year 2000.

ICT has recorded very significant economic and organizational impacts. The following statistics illustrate the magnitude of ICT impact on global economy-

- Business investment in IT reportedly accounts for 50% of new investment in capital equipment (Gerry, 1976);
- Investment in IT increased by 350% while during the same period net plant and equipment declined by 25% (Russell, 1996).

ICT has been both an analyzing force and a cause of the reshaping of organizations, including factors such as the shrinking of middle management, cluster/team alternatives to the traditional command hierarchy, and the rise of the role of the knowledge worker. Also, ICT is an integral component of the "re-engineering" movement towards redesigning organizational activities (Robert, 1996).

However, it should be noted that ICT is not absolutely organizational panacea, but owing to the structural changes that characterize information, organization or society, it develops some forms of deterioration of working conditions such as: mental fatigue, stress, constant control, and a demanding pace of work, pressure from clients and the weight of uncertainty. All of these factors have their origin in the organization rather than in the material. These factors and their impact can be called "intensification" or "growing density" of work (Peter, 2003)

2.Research Method

The study was carried out in four selected manufacturing industries in Nigeria. These four manufacturing industries were selected purposively after several advocacy surveys of some manufacturing industries that use ICT facilities to produce different commodity for the consumption of the people. They are: Niger Match Industry Limited (NML); Askar Paints of Nigeria Limited (APL); Frigoglass Cool Division (FCD) and Seven-Up Bottling Company (SBC).

Data were collected at firm and workers' level. At the firm level, the inventories of ICT capabilities and innovations in the selected manufacturing industries were documented, including the capital investment on ICT utilities in the last 10 years using two (2) specific data collection tools- (a) Secondary data sources (e.g. company records), (b) In-depth interviews with 20 heads of units in the selected manufacturing industries. At the workers' survey, questionnaire was administered to the workers selected across all units.

Thus, 26.5 per cent of the total work force (1268) responded to the questionnaire survey (totaling 336 workers). Hence, the sample distribution across the selected industries were 20 workers (1.6%) in APL, 156 workers (12.3%) in NML, 80 workers (6.3%) in FCD, and 80 workers (6.3%) in SBC using the Quota sampling technique.

The quantitative data collected were analyzed using the SPSS computer package. These descriptive statistics were presented using mean, frequency tables, percentages and cross tabulations tables. Secondary data sourced from firms records and Quarterly bulletins were analysed using content analysis, and categorization of variables. Qualitative data from in-depth interviews conducted with the twenty heads of units were analysed using Text Base Beta computer package, while results were presented using the ZY Index Tables.

3.Findings And Discussion

3.1.Inventory Of ICT Facilities / ICT Policy

Table 1 shows the ICT facilities available in each of the selected manufacturing industries. The information in the table shows that SBC and FCD have the same types of ICT facilities. This simply shows that the two industries are ICT Intensive users. The other

two manufacturing industries, that is, APL and NML have low capabilities. Both are Non-Networked ICT users because they do not have Internet access, internal and external e-mail. These three ICT facilities are very important in every organization because they give an organization access to the rest of the world.

The table also shows that none of the selected manufacturing industries endorses radio and walkie-talkie. This is because those two facilities are outdated, while more sophisticated facilities are now in use. Finding also unveiled that all workers in all the industries are aware of all the ICT facilities available in their respective units or industries. This is so, because social interactions, whether formal or informal are encouraged in all organisaions and more so, no unit is independent of another. Findings show that Mobile phone (GSM) as one of the newly introduced ICT facilities in Nigeria is widely used by workers across organisations. In some organizations, the management purchases it for their senior staff (managers) in order to facilitate effective communication (for instance, APL.).

ICT FACILITIES	SBC	FCD	APL	NML
Computer system	+	+	+	+
Telephone	+	+	+	+
Internet access	+	+	-	-
Internal e-mail	+	+	-	-
External e-mail	+	+	-	-
Local Area Network (LAN)	+	+	+	+
Wide Area Network (WAN)	+	+	+	+
Computerized Total Control Measure	+	+	+	+
Televisions	+	+	+	+

Table 1: Qualitative Overview Of ICT Facilities Available In The Selected Industries.
Source: Field Survey, 2005.
Key: + = ICT Facility Available, - = ICT Facility Not Available

Units in SBC	No. of workers	Computer	Telecom	Internet	Internal. Email	External. E-mail	LAN	WAN	CTCM	Television	Level of ICT
Administration	68	15	4	≈	≈	≈	≈	≈	-	1	
Production	100	15	3	≈	≈	≈	≈	≈	4	-	
Marketing	150	20	4	≈	≈	≈	≈	≈	-	-	
Fleet & Transport	13	1	1	≈	≈	≈	≈	≈	-	1	**High**
Computer	10	6	1	≈	≈	≈	≈	≈	-	-	
Total	**353**	**57**	**13**						**4**	**2**	
Units in FCD											
Administration	50	6	4	≈	≈	≈	≈	≈	-	1	
Production	150	5	6	≈	≈	≈	≈	≈	6	-	
Marketing	30	4	3	≈	≈	≈	≈	≈	-	-	
Engineering	14	3	2	≈	≈	≈	≈	≈	-	1	**High**
Finance	25	3	3	≈	≈	≈	≈	≈	-	-	
Purchasing	25	2	4	≈	≈	≈	≈	≈	-	-	
Total	**294**	**23**	**22**						**6**	**2**	
Units in APL											
Administration	14	2	4	-	-	-	≈	≈	-	1	
Production	52	1	2	-	-	-	≈	≈	2	-	
Marketing	10	1	2	-	-	-	≈	≈	-	-	**Medium**
Establishment	4	-	2	-	-	-	≈	≈	-	-	
Total	**80**	**4**	**10**						**2**	**1**	
Units in NML											
Administration	41	3	3	-	-	-	≈	≈	-	1	
Production	389	2	4	-	-	-	≈	≈	3	-	**Medium**
Marketing	15	1	3	-	-	-	≈	≈	-	-	

Engineering	74	1	2	-	-	-	~	~	-	-	
Finance	18	2	3	-	-	-	~	~	-	-	
Purchasing	4	1	3	-	-	-	~	~	-	-	
Total	**541**	**10**	**18**	-	-	-			**3**	**1**	

Table 2: An Overview Of The Inventory Of ICT Facilities In Each Unit Of The Selected Manufacturing Industries In Nigeria. Sources: - Field Survey, 2005.
Key: (~ = Internet Connectivity), (- = Not Available)

Table 2 shows that all the units in the selected industries have computers facilities except for the Establishment Unit of APL which has no single computer. All the computers in all the selected manufacturing industries are Local and Wide Area Networked (LAN and WAN) but only SBC and FCD are Internet connected and with facility for Internal and External e-mailing. However, a comparison of the available ICT facilities in each firm and the number of workers, suggest that the administrative units rather than the production units have the largest number of ICT facilities especially computers. This is also to confirm that the use of ICT facilities to aid direct production activities is a generally low level among manufacturing industries in the country. Only SBC and FCD out of the 4 selected industries have strong ICT policy requirement for their workers to be computer literate, and to readily apply this in carrying out their day-to-day activities. The Non- Networked ICT Users (APL and NML) equally have ICT policy but not strictly followed or practiced as SBC and FCD. (SBC and FCD Quarterly Bulletin, 2000). All the selected industries bear the financial obligation of training their staff on the use of ICT facilities and / or new software packages although such trainings depend on fund availability.

Generally, a high capital outlay is reported on ICT facilities acquisition and maintenance as they have access to foreign funds. SBC and FCD industries have invested a lot of money on ICT facilities. For example, SBC has just imported 250 PCs as at the end of August, 2003 (Abiola, 2003 - SBC, Quarterly Bulleting Publications, March 2003).

Contrary to the above, APL and NML, which are on the small scale, operate ICT facilities with caution. They spend little on ICT facilities because of lack of funds. Where ICT facilities are available, there is usually a technical support for equipment maintenance and training of staff.

Table 2 shows that FCD and SBC have a high level of ICT facilities. They are large-scale firms, economically buoyant, could access foreign financing. Richard D. and Richard H., (2001), in their work on ICT in Small-scale Enterprises in Africa (Botswana) noted that the size of an industry is a strong principal factor that influences ICT intensity within an organization. They further noted that the intensity of ICT in any organization is a function of the organizational annual turnover. While NML and APL have a medium level of ICT use, they are Non-Networked ICT Users (that is, they have computers, telephones in their premises but with no external network connections). This is the category most enterprises in Nigeria belong to.

3.2.ICT And Organizational Development And Changes

Change and development are inevitable in any organization whether or not the organization plans for it. Change may be positive or negative. The adoption and use of ICT facilities in the selected manufacturing industries recorded positive changes and development, but at different degrees. Some of these events are captured in the interview extracts presented below;

3.2.1.Extract 1: Interview With Head Of Marketing Unit, (SBC)

"There has been lots of changes and development with the use of ICT in this company. Job description has definitely changed with the use of "NA VISION" a newly ICT based accounting package. Job is redesigned and reassigned for staff. We now have computer unit. These changes and development enhance the standard of our work, especially with this 100% "NAVISION" package which has drastically reduced the paper work. Now manual paper work is reduced to the minimum, thereby reducing the cost of stationery, the time spent on writing, and the space for archives. Now with ICT facilities, we can prepare report easily and send it to any part of the country with the aid of the internet".

3.2.2.Extract 2: Interview With Head Of Computer Unit, (SBC)

"In respect to development, the company is no doubt developing, for example the VSAT-Satellite communication is a fast and reliable dedicated communication network and it is now operational in all regions as well as in the Head Quarters in Lagos. This is a major development in the firm because the firm no longer depends on Nitel and radio for communications. The network allows access to both SBC users and the Internet. The Internet is another major development which has grown few years ago, which is accessible to anyone who has a PC, phone and modem for various reasons".

The non-networked ICT users industries such as Askar Paints and Niger Match Ltd, equally experienced structural changes and development in one form or the other. This is also captured in the Interview Extracts below:

3.2.3.Extract 3: Interview With Head Of Marketing Unit, (APL)

"Using the marketing unit as a case study, more positions have been created to make work faster and easier. We now employed graduates to fill the new positions, that is, Depot Manager assisted by sales representatives in all depots. This was not in place before. Work descriptions changed from manual to more technical although not in all units. These changes aid the attainment of overall organizational goals.

3.2.4.Extract 4: In-Depth Interview With Head Of Purchasing Unit, (NML)

"ICT adoption and uses especially in manufacturing industries is a laudable project which facilitates structural changes. These changes have redefined work process and heightened specialization and skill building. Each worker is given more responsibility at work, especially in the area of accomplishing a particular task. Now, the cost of management (especially in the area of supervision has reduced yet the achievement of organisational goals is more assured".

3.3.Overall Contributions Of ICT To Overall Goals

The contributions of ICT in the selected manufacturing industries cannot be over emphasized especially in facilitating organisational goals. Table 3 presents data on the assessment and the overall contributions of ICT to the organizational goals in the respective industries. ICT use in SBC, FCD and NML is "efficient" (see Table 3). All these describes as generally as industries invested huge capital on ICT facilities while APL with low level of ICT use, spent little or nothing on ICT facilities. The interview Extract 13 below reinforces the impact of ICT on organizational goals and development.

Industry	V. Inefficient		Inefficient		Efficient		V. efficient		Total	
	No	%	No	%	No	%	No	%	No	%
SBC	-	-	1	1.3	61	76.3	1	22.5	80	23.8
FCD	-	-	29	36.3	47	58.8	4	5.0	80	23.8
APL	1	5.0	11	55.0	7	35.0	1	5.0	20	6.0
NML	-	-	19	12.2	128	82.1	9	5.8	156	46.4
TOTAL	**1**	**0.3**	**60**	**17.9**	**243**	**72.3**	**32**	**9.5**	**336**	**100**

Table 3: General Assessment And Contributions Of ICT To Overall Goals In The Industries.
Source: Field Survey, 2005

3.3.1.Extract 5: Interview With Head Of Administration Unit, (FCD)

"The changes helped the attainment of our goals because workers are now exposed to new skills, new management styles, and more freedom over work processes. On the whole, the changes brought about by new information technologies helped to reduce costs and risks. For example, our marketing manager make a lot of business deals by a mere tap on the buttons".

3.4.Constraints Facing Adoption And Use Of ICT In The Sampled Firms

Table, 4 presents 4 major problems confronting the selected manufacturing industries. These include - lack of capital investment (61.3%); poor electricity (61.3%); high maintenance cost of ICT facilities (57.1%); and high cost of ICT (60.4%). The four problems highlighted above are peculiar to the Non- Networked ICT users (APL and NML). When observed critically, it should be noted that the problems are capital- oriented problems. It means that the Intensive ICT Users (SBC and FCD) are totally exempted from these problems because the level of ICT facilities currently available in these industries is high, indicating lots of capital investment. Existing literature continue to support the fact that ICT facilities are highly capital intensive in (SBC, 2003, FCD, 2000 and Stiglitz, 2000). Another major problem confronting the adoption and use of ICT is the low level of education among production workers, such that they could not understand simple computer-based design instructions. Data from Botswana corroborates this finding. In Botswana, both small- and medium- scale enterprises are faced with problems of poor management skill, lack of access to improved management skill, inability to acquire and retain skilled workers, and lack of access to skill training (Richard and Richard, 2001).

Other area of concern is in the area of loss of job because of ICT adoption and use. In all the industries visited, none of them had concern on the impact of ICT on employment status. Extract 14 presents some opinions on this from a marketing manager. The Extract supports the fact that ICT in these manufacturing industries has not negatively impacted on job security in general.

	YES		NO		TOTAL	
PROBLEMS OF ICT FACILITIES	**N**	**%**	**N**	**%**	**N**	**%**
Low capital investment	206	61.3	130	38.7	336	100.0
Lack of trained personnel in ICT use and development	256	76.2	80	23.8	336	100.0
Poor electricity	206	61.3	130	38.7	336	100.0
Cost of ICT facilities too high	203	60.4	133	39.6	336	100.0
Maintenance cost of ICT is too high	192	57.1	144	42.9	336	100.0
Poor telecommunication Infrastructure	84	25.0	252	75.0	336	100.0
Employee's resistance to use of ICT facilities	58	17.3	278	82.7	336	100.0
No training opportunity for staff in the area of ICT technology	267	79.5	69	20.5	336	100.0
Employee display negative Attitudes towards ICT adoption & Use in their respective units.	56	16.7	280	83.3	336	100.0
Many employees are too old to Change to ICT demand and standards	72	21.4	264	78.6	336	100.0

Table 4: Current Problems Encountered By Manufacturing Industries After The Adoption And Use Of ICT Facilities
Source: Field Survey, 2005

3.4.1.Extract 6: Interview With The Head Of Marketing Unit, (SBC)

"I can understand the concern people have when they hear about computerization. When people heard that Navision would be implemented throughout the companies there were real concerns about job security. So far after the adoption of Navision in seven regions, I can confirm that there has not been one member of staff who has been retrenched because of ICT".

4.Conclusion

This paper explored the adoption and use of information and communications technology (ICT) in manufacturing sector in Nigeria. The study identifies the relevant ICT facilities used and lacked in the manufacturing firms in Nigeria. The survey further noted that no matter the level of ICT facilities adopted and use in a manufacturing industry it also has its level of organizational and structural impacts (changes) on the firm. This shows that the contributions of ICT to manufacturing industries cannot be emphasized. The study shows that workers in Nigeria manufacturing industries are not properly expose to ICT training in order to improve their understanding on how to optimally use the ICT facilities in their firms. GSM as one of the newly introduce in Nigeria play a significant role in aiding effective communication with co-workers in the markets or the customers especially in APL.

5.Recommendation

- The Nigerian government should help in reducing the cost of interconnectivity and general Information and Communication Technology (ICT) access. This will ensure public access to cheap and fast telecommunication services.
- The Ministry of Commerce should make it compulsory for all manufacturers to include purchasing of necessary ICT facilities into their annual budget.
- Manufacturer should make sure their staff benefits form the workshops and seminars on ICT use and maintenance in their respective industries.

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