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Relationship between Information Technology (ICT) adoption and Warehouse Operations at Sugar Manufacturing Firms in Kenya

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Abstract: The world is growing in technology and most industries are adopting ICT in their operations. Information technology involves development, maintenance and use of computer systems software and networks for processing and distribution of data. Most industries used manual systems that were not efficient and effective. In Kenya, the existing competition between sugar firms has pushed for the development of new technologies in their operations to make them satisfy their customers' demand. The principle requirement for controlling a warehouse is harnessing the power of technology to maximize a facility's potential. A few studies have attempted to investigate the extent of warehouse information technology adoption by industries in the country. However, there is limited literature on the effect of ICT adoption on warehouse operations. It is on this basis that the study analyzed the relationship between ICT adoption and warehouse operations of sugar firms in Kenya, with specific reference to Sony Sugar Company. This study was guided by a self conceptualized frame work in which ICT was the exogenous variable while Warehouse Operation was the outcome variable. It also adopted both descriptive and correlational research design. The target population was 500 warehouses management staff and a purposive sample of 150 respondents was taken. Primary data were collected using questionnaires and relevant literature reviewed to bring out the study gap. Data were analysed using descriptive statistics and peason correlation to establish the level of bivariate association among the study variables. The study established a significant positive association between ICT adoption and warehousing operations. Internet system, bar coding and scanning were largely used in warehousing operations and effectively enhanced operations as reported by 83.8% of the respondents. The study recommends continued adoption of ICT by the managers to strengthen their operations at the ware houses. Findings of this study may be used as a basis for policy formulation at the firm level and as a source of literature for subsequent studies in the same field.

Keywords: *Information Technology (ICT) adoption and Sugar Manufacturing Firms*

I. BACKGROUND INFORMATION

Warehouses are essential components of any supply chain. In a warehouse, items are handled in order to level out the variability and imbalances of the material flow caused by factors such as seasonality in demand, production scheduling, transportation, and consolidation of items (Gao *et al.*, 2007). Inventories in warehouses are capital-intensive assets that require storage areas, handling equipment, and information systems. In addition, warehouse operations are repetitive labour intensive. The capital and operating costs of warehouses represent about 20-25% of the logistics costs (Frazelle, 2002, Baker & Canessa, 2009). Therefore, improvements in the planning and control of warehousing systems can contribute to the success of any supply chain.

A warehouse is typically divided into functional areas that are designed to facilitate the material flow (Tompkins et al., 2003). The main warehouse areas include: receiving, reserve, forward storage, and shipping. Operations in the receiving area include the processing (i.e., unloading) of carriers, item identification, and quantity and quality inspection. Received items are then moved to a storage area or directly to the shipping area. The storage area is often divided into a reserve and a forward storage area. The reserve storage area covers typically distant and heavily accessible locations, e.g., the uppermost part of a rack, and is used to ensure the replenishment for the forward storage area. Customer demand is primarily satisfied from the forward storage area, where the items are typically stored in convenient size and the storage locations are easily accessible. In the shipping area, items are sorted, consolidated and loaded on the carriers. While this is a general material flow in a warehouse, the actual material flow depends mainly on the role of the particular warehouse in the supply chain. Specialized warehouses are established to fulfil the different requirements, e.g., production warehouse, distribution warehouse, and cross-dock. The main function of a production warehouse is buffering and storage, it supplies raw or semi-finished material for production and may prepare finished items for shipment; the typical objective is the minimization of operation and investment costs given the storage capacity and response time (Rouwenhorst et al., 2000).

Karimi and Namusonge (2014) observe that warehouse management systems (WMS) have been available since the earliest computer systems and were allowed simple storage location functionality. Furthermore, the implementation of a WMS is often complex. Project planning is critical to the success of any WMS implementation. Therefore, there still remains the challenge of adoption and implementation of the system whilst still operating the warehouse. Alan (2006) noted that with the continuing changes in technology and equipment, warehousing logistics is an increasingly competitive aspect of the supply chain. The competitive pressure implies an ongoing demand to achieve more efficiency with every cubic foot of warehouse space. Vendors are utilizing new software and other tools to provide a heightened level of service with each step in the warehouse process. There are many components in working to achieve the highest level of efficiency when dealing with

warehousing logistics. The process involves establishing realistic objectives and managing changes in a realistic manner.

Eliminating wasteful or inefficient elements of daily procedures is an ongoing process that involves the entire warehouse team. Diligent review of the standard operating procedures and a consistent approach to efficiency are essential parts of achieving a lean operation. This is especially important in a growing organization; supply chain typically focuses on the application of warehouse management system (WMS) technology on automation of the outbound finished goods process. Warehouse management system (WMS) is designed to automate, integrate and track all activities performed within the facilities. The activities include services such as receiving, put away, picking and packing and shipping. Roodbergen and Vis (2009) have therefore posited that the effectiveness of e-Portal applications within the WMS environment needs further investigation.

With many sugar firms embracing the information technology systems in operations, there is still inefficiency in service delivery especially in the warehouses where trucks wait for long before they are served in the receiving of goods and at dispatch. Scavarda *et al*., (2012) studied how information technology revolution has affected distribution operations, providing many benefits from labour productivity gains to accuracy and improved inventory turns. They argued that warehouse management is the critical part of any business and in order to manage efficiently we need IT systems and tools. In order to deliver targeted warehouse objectives and transform warehouse into profit centre, it is essential to understand warehouse objectives and make use of the people, strength, processes and technology to achieve the same. A warehouse management system provides the information necessary to manage and control the flow of the product in a warehouse from receiving to shipping. However, they failed to demonstrate how the integration of bar coding technology, radio frequencies communications equipment, hardware and software in the warehouse management system (WMS) benefits warehousing operations.

Conceptual Framework

Generally, Information technology is the use of computer software on operations. Warehouse management system is a software application that supports the day- to- day operations in a warehouse that controls the movement and storage of materials in a warehouse. Electronic Data Interchange (EDI) on the other hand is the exchange of documents electronically in a safe environment. E-portal provides customers with real time information anytime anywhere. Since E-portal is integrated with WMS, clients can manage their orders and view inventory pay invoices. Radio frequency and bar-coding (RFB)-capture transition and store information in real time. When an inventory arrives, its details are captured in WMS. Inventory management system- is software for tracking inventory levels, orders, sales and delivery. Receiving- is the inspection of goods that arrive in the warehouse and preparation for storage. Put Away- is the tagging and matching goods to their appropriate location within a warehouse. Pick and pack- it entails processing small and large quantities of products often track loads, picking the right product for each destination. Dispatch- once the items are picked and moved to dispatch area they are sorted out according to the route for delivery by transport department. The hypothesized relationship between the ICT and Warehouse operations is captured in Figure 1

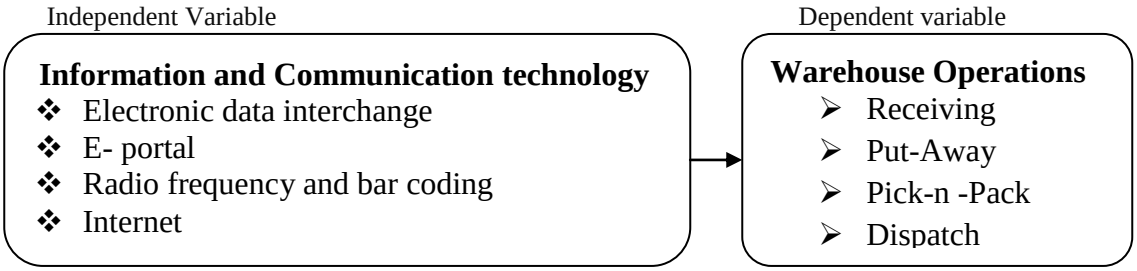

Figure 1: Relationship between information technology and warehouse operation

II. RESEARCH METHODOLOGY

Research Design

The study adopted both descriptive and correlational research designs. Descriptive design helped in generating detailed description of the ICT dimensions and elements of warehouse operations. Correlation helped in paving way for the determination of the association between the study variables.

Study Area

The study was conducted in South Nyanza Sugar Company (SONY). The Company was established in 1976 and it is located in South-Western Kenya in Awendo region of Migori County. The Company serves over 250,000 cane farmers drawn from Migori, Kisii and Homa bay counties. The major cane growing zones are Homa bay, Gucha, Transmara, Kuria, Migori, Uriri, Rongo, Kisii south, Ndhiwa and Awendo. The company was selected due to its wide area of coverage.

Population and Sample

Out of a population of 500 employees, a total of 150 respondents were purposively selected for the study. Purposive sampling technique was preferred to other techniques since it enabled the researchers to get respondents who were knowledgeable on the ICT and Warehouse operations at Sony Sugar Company.

Data Collection and Analysis Methods

Primary data were collected through questionnaires with both closed and open ended questions. Secondary data were from the warehouse records kept at the company. The collected data were analyzed using measures of central tendencies and correlation to establish the bivariate association between the ICT and

warehouse operations. Likert scale was used to capture some of the qualitative responses in numerical format

III. RESULTS AND DISCUSSIONS

Figure 2 shows that most (63%) of the respondents were male while 37% were female. This was probably because most of the warehouse operations required intensive labour that could well be handled by male employees.

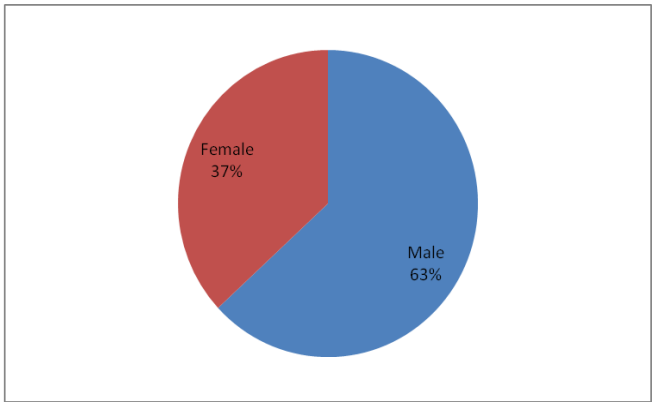

Figure 2: Gender of Respondents

In Figure 3.0, it is overt that most 42 (37.8%) of the respondents' age bracket ranged between 36-45 years, 28 (25.2%) were aged 46-55 years, 17 (15.3%) were aged within 26-35 years, 15 (13.5%) were aged less than 25 years while only 9 (8.1%) were above 55 years of age. This shows that 71.1% of employees at the warehousing department were aged 36 years and above.

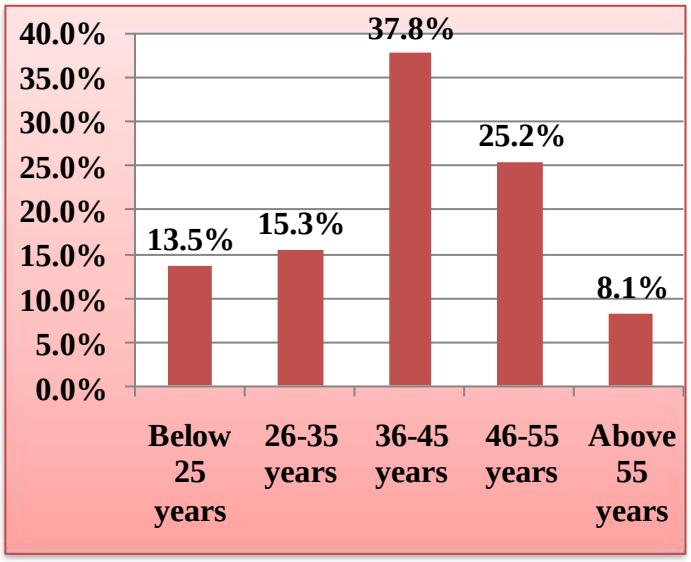

Figure 3: Respondents age bracket

Results in Table1 show that 38 (34.2%) of employees had diploma level of education, 37 (33.3%) had degree, 17 (15.3%) had certificate, 11 (9.9%) had masters and 8 (7.2%) were found to have secondary level of education. This shows that all employees had at least tertiary level of education and therefore capable of understanding and relaying information on their warehouse activities.

The study also sought respondents' opinion on their work experience at the warehousing department. The results are given in Figure 4. Figure 4 shows that 51 (45.9%) of employees had worked for 4-6 years, 29 (26.1%) for 7-9 years, 25 (22.5%) for less than 3 years while only 6 (5.4%) reported to have worked for 10 years and above. From the findings, it is clear that majority of employees had work for a considerable period and thus were in a position to understand how ICT had affected warehousing operations.

Table 1: Education level of employees

level	Frequency	Percent
Secondary	8	7.2
Certificate	17	15.3
Diploma	38	34.2
Degree	37	33.3
Masters	11	9.9
Total	**111**	**100.0**

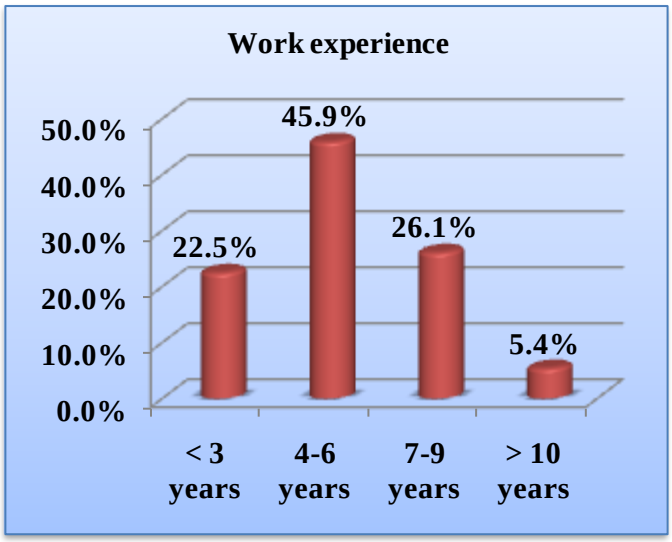

Figure 4: Respondents work experience

In order to determine the extent to which respondents participated in the study, the employees were asked to indicate areas and sections to which they worked. The analysed data is given in Figure 5.0

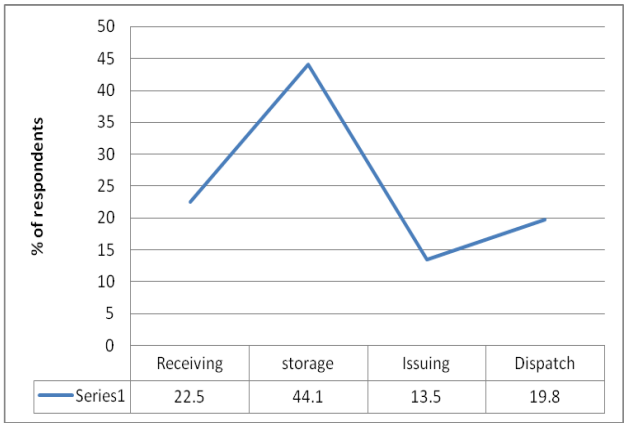

Figure 5: Areas of operations in warehousing department

Results show that 44.1% of respondents worked in storage section, 22.5% worked in receiving section, 19.8% operated from dispatch section while 13.5% worked in issuing section.

Level of use of ICT Systems and Applications on Warehousing Operations

At first, the study sought to know the nature of computer training that the employees undertook. Karimi and Namusonge (2014) inform that an understanding of computer operation is essential in a working environment that uses a computerized warehouse management system. Their responses were captured in Table 2.

Table 2: Nature of computer training that respondents undertook

Response	Frequency	Percent
None	13	11.7
Computer packages	86	77.5
Procurement and packages	8	7.2
Computer packages and databases	4	3.6
Total	**111**	**100.0**

Findings show that majority 86 (77.5%) had training on basic computer packages, 8 (7.2%) had computer packages together with procurement training and 4 (3.6%) had training on computer packages and databases. Only 13 (11.7%) said that they did not have any computer certification training course. From the results, it is clear that majority of employees had basic computer knowledge and therefore could be in a position to use ICT applications that are used in warehousing operations. The findings concur with study conducted in Kenya by Karimi and Namusonge (2014) who established that (90%) of respondents indicated they had undergone some form of computer training while a minority (10%) had not. The respondents noted that they had acquired knowledge of the basic computer operating system particularly Microsoft Windows System. Further, 60% of the respondents indicated they had been trained on the use of the University's Sage Enterprise Resource Performance (ERP) system. The study further sought to determine the extent to which the Company utilised information communication technology applications like; electronic data interchange, radio frequency bar coding on day-to-day warehouse operations.

Composite statistics shows that the utilisation of ICT appliances in warehousing operations was on average (M=3.15 and SD=1.19). This shows that information and communication technology adoption has not yet been fully embraced at the Company. It also revealed that internet was often used with a mean of 4.21 and standard deviation values of 0.81. This is a likely indication that majority of employees communicated and exchanged data through use of email. The findings concur with Obogne and Lidasan (2005) who established that 89% of private sector and 100 percent of government authority was aware of the usefulness of internet technology in Manila. The second item often used was mobile data communication (M=3.99 and SD=0.92). The third item often used was bar coding and scanning (M=3.64 and SD=1.11). The last application that was often used in warehousing operations was automatic picking system in the factory (M=3.53 and SD=1.23). From the results in Table 3, it is evident that the company had not integrated all ICT applications systems in day-to-day operations.

The results of the study further showed that the following systems were used occasionally/sometimes as observed by the employees; electronic data interchange (M=3.41 and SD=1.45), data warehouse (M=3.37 and SD=1.21), electronic commerce (M=3.23 and SD=1.49), container storage and planning system (M=3.06 and SD=1.20). The findings of the study are in contrast to Obogne and Lidasan (2005) who found a high percentage of awareness both for the private and government authorities on usage of EDI. Moreover, the authors established that more than half of the government authority identified it while there is a low percentage rate from the private sector. Other ICT systems found to be moderately used in were; in-vehicle navigation system (M=2.97 and SD=1.40), container equipment control system (M=2.90 and SD=1.30), geographic information system (M=2.82 and SD=1.09), global positioning system (M=2.78 and SD=1.13), ob-board data communication (M=2.69 and SD=1.02), radio frequency identification (M=2.55 and SD=1.27 and lastly freight and fleet management that recorded the lowest means 2.51 and standard deviation on that category. It was established that Inmarsat was rarely used (M=2.31 and SD=0.97) in warehousing operations. The findings concur with Obogne and Lidasan (2005) who found the non-utilized technologies as on board data recorder, in-vehicle navigation system, Inmarsat and freight and fleet management.

Table 3: Level of ICT application use in warehousing operations

ICT applications in warehousing operations	N	Min	Max	Mean	Std. Dev	
Internet	111	3.0	5.0	4.21	.81	
Mobile data communication	111	2.0	5.0	3.99	.92	
Bar coding and scanning	111	1.0	5.0	3.64	1.11	
Automatic picking system	111	1.0	5.0	3.53	1.23	**Often**
Electronic order system	111	1.0	5.0	3.52	1.39	
EDI (Electronic data interchange)	111	1.0	5.0	3.41	1.46	
Data warehouse	111	1.0	5.0	3.37	1.21	
Electronic commerce	111	1.0	5.0	3.23	1.49	
Container storage and planning system	111	1.0	5.0	3.06	1.21	
In-vehicle navigation system	111	1.0	5.0	2.97	1.40	
Container and equipment control system	111	1.0	5.0	2.90	1.31	
Geographic information system	111	1.0	5.0	2.82	1.10	
Global positioning system (GPS)	111	1.0	5.0	2.78	1.13	**Sometimes**
On-board data communication	111	1.0	5.0	2.69	1.03	
Radio frequency identification	111	1.0	5.0	2.56	1.28	
Freight and fleet management	111	1.0	5.0	2.51	1.12	
Inmarsat	111	1.0	4.0	2.32	.97	**Rarely**
Average results		**1**	**5**	**3.15**	**1.19**	

To determine the effect of information and communication technology adoption on warehousing operations at the company, a five points Likert scale ranging from; very effective (5), effective (4), moderate (3), ineffective (2) and very ineffective (1)was used to capture the respondents' perceptions and the findings given in Table 4.

Table 4: Performance of warehousing operations

Performance	Frequency	Percent
Moderate	18	16.2
Effective	75	67.6
Very effective	18	16.2
Total	**111**	**100.0**

Most of the respondents 67.6% asserted that their institutional warehousing operations level was effective and an equal proportion (16.2%) observed that it was very effective and moderate. This implies that the levels of operations are relatively high. To check on the relationship that existed between ICT systems adoption and warehousing operations, a Karl Pearson product moment correlation was computed by correlating scores for ICT systems adoption against level of warehouse operations scores at the Company. The results are presented in Table 5.

Table 5: Effect of ICT adoption and warehouse operations the company

Correlations			
		ICT Applications utilisation	**Level of warehouse operations at Sony**
ICT Applications utilisation	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	111	
Level of warehouse operations	Pearson Correlation	.258**	1
	Sig. (2-tailed)	.006	
	N	111	111

**. Correlation is significant at the 0.05 level (2-tailed).

The results show that there exists a positive significant degree of correlation (r=0.258, p = 0.006) between ICT adoption and warehouse operations. This implies that a significant 25.8% level of the warehouse operations is positively associated with ICT utilization. The results are in tandem with Karimi and Namusonge (2014) who showed that (95%) of respondents indicated that the system effect was positive while a minority (5%) indicated that the effect of the system was negative.

CONCLUSION AND RECOMMENDATION

Based on the results, the study concludes that ICT was a critical component to effective operations of warehouses in the sugar industry and therefore, should be utilized more to improve on the logistical efficiency at the sugar firms. Further research should be conducted in this area using time series data to corroborate the study findings. This is because most of the data used in the analysis were mainly on the perceptions of the respondents which may vary from time to time.

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