



Impact of technology on safety of dockworkers at the port of Tema

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Abstract

To ensure uninterrupted port operations and reduce port congestion, port should be upgrade to the prevailing standards. Today, mechanization and automation is the essence of port work. Safety is of paramount interest in any human endeavour, hence this work seeks to find out how the introduction of technology in the port of Tema has affected the operations of the port with regards to safety of ships and cargo. A sample of 65 respondents was selected and it cuts across all the departments considered to be relevant to the topic under investigation. The study revealed that even though there was still records of accidents after the introduction of technologies in the port operation, it could be noted that the accidents were not as a result of the introduction of these new technologies but as a result of some poor safety measures during duties with which occupational hazard cannot be completely dealt with. There was a reduction in the number of accidents after the introduction of technology indicate positive effect of the technologies and study recommends periodic training of personnel.

Keywords: technology, safety, dockworkers, port operations

Introduction

Port operation has evolved from the use of push trucks in the carriage of goods to advanced mechanization and computerization. Port operations are a necessary tool to enable maritime trade between trading partners. To ensure smooth port operations and to avoid congestion in the harbour, it is inevitable to permanently upgrade the port's physical infrastructure, invest in human capital, fostering connectivity of the port and upgrade the port operations to prevailing standards. Port operations has been defined by Osaretin (2006) ^[1], Otieno, *et al*, (2011) ^[2], as cargo handling (or moving) activity, performed by a designed company (gang or team), consisting of labour and machines. It is also defined as the operation of a wharf and other port facilities, operation of port passenger transport service, operation of cargo loading or unloading, haulage and warehousing services within a port area and so on Sitorus, (2003) ^[5] view the port operations as all policies, reforms and regulations that influence the infrastructure and operations of port facilities including shipping services. Today, mechanization and automation is the essence of port work. Furthermore, the introduction of the container has been at the center of the growth and development of advanced mechanization and information technology that has developed, to define the character of modern port operations.

The port of Tema, till 2000, was a service port and management began a programme to increase the participation of the private sector in the provision of services and facilities to ships and cargo in line with the government's strategic port development policy to transform the ports of Ghana from service ports to landlord ports. By 2001, stevedoring and shore handling licenses as well as joint venture and concession agreements had been signed and private companies that had the capacity to introduce modern operational equipment and procedures into cargo handling (GPHA, 2012) ^[7]. Port operations at the

Tema port basically include cargo handling, and handling of vessels. However, the country's drive towards a landlord port management system, coupled with the government's inability to invest leaves port authorities with no option than to turn to the private sector to invest in their ports (Bezern, nd.).

Since safety is of paramount interest in any human endeavour and with reference to the high accident rate between the periods of 2003 to 2018 (refer to table 2), this work seeks to find out how the introduction of technology in the port of Tema has affected the operations of the port with regards to safety of ships and cargo. To achieve the objective of the study, the following issues were analysed:

- What new technological improvements have been made in the port of Tema for the past 15 years?
- What safety issues have arisen in the past 15 years with regards to the technology being used?
- How does technology affect the safety of dock workers?

Study Area

The Tema Port was chosen for the study because of its being the major entry point for the country's imports. The Port of Tema is more than a mere loading or unloading place for goods. It also serves as a traffic junction where goods are transshipped and transit cargo destined for the hinterlands/landlocked countries of Burkina Faso, Mali and Niger are handled. The Port of Tema is managed and operated by the GPHA and the port's role is to maintain a smooth flow of goods to and from Africa, Europe, America and worldwide (GPHA Handbook, 2002/2003) ^[3]. It is equally a port with a wide range of industrial and commercial companies, producing or handling among others petroleum product, cement, food items, iron and steel, aluminum products and textiles.

Research Methodology

The research methodology explains the processes, methods and techniques use in attempting to discover what we want to know. Research methodology as defined by Kothari, (2004) ^[4] is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically. In research methodology, various steps are adopted by a researcher in studying his research problem along with the logic behind them.

Population, Sample size and technique

The population consisted of the Operations Section of the Port of Tema. This was stratified as follows: Marine Operations department, Stevedore department, Logistics department and Marine Engineering Department. A sample size of 65 employees was used for the study. The 65 respondents were selected through simple random sampling and cuts across all the departments and the departmental heads are selected using purposive sampling techniques.

Data Analysis method

Statistical Package for The Social Sciences (SPSS version 16) and Microsoft excel were used to analyze the information. Based on the questionnaire, frequencies and percentages were used for all variables of this study.

Data analysis and Discussion

Selection of Respondents

The data was obtained from four (4) main departments considered to be relevant to the topic under investigation. With regards to the departments selected for this research, out of the total of 65 respondents, 20 respondents each representing majority were from the Marine Operations and Stevedoring departments with a percentage of 30.77 each while the Logistics department recorded the least percentage of 15.38 with a sample size of 10. 15 respondents were selected from Marine Engineering comprising of 23.08% of the respondents.

Educational Background of Respondents

On the issue of education 1.54% representing 1 respondent had Junior High School education followed by 21.54% representing 14 out of the 65 respondents had Senior High School education. 6 respondents (9.23%) had 'O' Level education while 23 out of the 65 respondents (35.88%) had Diploma education. 30.77% (20 respondents) degree level of education and 1 out of the 65 respondents (1.54%) had a Master's degree. The majority of the respondents hold diploma followed by first degree. Thus, with such high level of education reported by the workers, the implication here is that workers have better understanding of their work environment. They are preview to the impact of modern technology adoption in organizations and institutions such as that of the Ghana Ports and Harbours Authority (GPHA). Therefore, they stand in a good position to assess the impact of modern technology on operations at the port.

New Technology Introduced into the Port since the Port Reform in 2003

The port of Tema prior to 2003 was a service port until the government's strategic port development policy to transform the ports of Ghana from service ports to landlord ports. Driven by the need to increase investment in the port, this move attracted private investors to participate in port

operations. This brought about the much needed investment in terms of new technology and management skills. Modern equipment has been installed and more continue to be added.

The interview conducted with the heads of the various departments revealed that most of the operations in the four departments under study have been digitalized with the installation of modern equipment such as high speed computers, closed-circuit television (CCTV) camera, JCB tele truck forklift etc. The heads of departments further revealed that systems such as the Fiber-optic systems, vehicle tracking systems, Ghana community Network (GCNET), and multi system vessel discharge are installed within the port to facilitate operations. The various state of the art installations according to the heads ensure a proper handling of cargo where containers discharged by vessels move through the Africa Coastal Services (ACS), Tema Container Terminal (TCT) and Golden Jubilee Terminal (GJT) for proper scanning and checks.

The newly installed technology as mentioned by the heads of the various departments was confirmed by the workers (respondents) when asked to list new technologies introduced in their departments. Thus, over 90% of the workers indicated (by listing) that there has been the installation of computers and CCTV cameras, and over 60% listed the cargo handling equipment and the vehicle tracking system. Table 1 below gives the distribution of new technologies installed as mentioned by the respondents.

Table 1: New technologies installed

Technology	Number of respondents	Percentage (%)
Computers	60	95.2
CCTV camera	58	92
Mobile cranes	29	46
GCNET	20	31.7
Cargo handling equipment	40	63.5
Tele truck forklift	21	33.3
Vehicle tracking system	43	68

Technological equipment used Daily

Further on the modern technological equipment, respondents were asked to indicate the technological equipment they use in the daily operations at the port. Out of the total respondents, 52.6% of the workers indicated that they use the container stackers. This followed by 19.3% who use the cranes in their daily activities. The forklift was used by 14% of the respondents to carry out their daily routine activities. The use of computers for daily routine activities was done by 10.5% of the respondents and only 3.5% use the ship gears in their daily activities at the port.

Impact of Technology on Port Operations

One of the objectives of the study to find out both the positive and negative impacts that technology has brought. Data for this part of analysis is both primary and secondary data. The primary data reveals the positive impacts of technology from workers' perspective and the secondary reveals accidents/incidents recorded within period under consideration. The secondary data was complimented by workers asked to indicate their experience of accidents in the course of work.

Positive impacts of technology on port operations

Interview with the heads (managers) of the departments indicated a positive impact in the installation of modern technology in port especially in the areas of record keeping, monitoring, efficiency and effectiveness of work, and safety at work. One of the heads mentioned that; *"Technological equipment installed has made record keeping easy. The equipment makes it easy to monitor the work environment without causing any fatalities and also readily makes information about cargo available making the work a bit easier and fast"*.

Another head (manager) added that; *"electronic systems installed has helped to reduce fraud that was associated with the old system of operation, speed up work, and also reduced the occurrence of accidents within the port"*.

The advantages of the modern technology in the operation of the harbour as revealed from the interview were confirmed by the respondents (workers) of the questionnaire. About 88% of the respondents pointed out that the installation of modern technology at the port has been advantageous and has impacted positively in their line of duty at the port. All the 88% of the respondents agreed that the use of the technological equipment has increased safety at the port.

Furthermore, respondents were asked to state some of the positive impacts the installation of modern technological equipment have brought to their work, their response was no different from that of the heads interviewed. Thus, they mostly stated that the technological equipment have made them work effectively and efficiently, the use of the equipment has reduce accidents and pollution in the port, made information sharing between subordinates and superiors and shipping agents easy, and reduced pilfering and fraud within the system. From the operation section of the logistics department, this respondent mentioned that;

"air pollution has reduced because the new equipment have air conditioners installed in them, therefore, operators need not to open their cabin to inhale poisonous gases and dust around the working area".

Negative impact of technology on port operations

An attempt to analyze the negative impact of modern technology from the workers perspective was made by asking workers to indicate whether they have been victims of any accident in the use of the newly installed equipment and the nature of the accident. Data gathered revealed that only a few of the workers have had accidents in the cause of operating equipment. Results indicated that only 12.7% of the workers have had accidents in the cause of operating the equipment. Even though number of workers involved in accidents was few, cut was high on the list. 5 out of the 8 workers involved in accidents were cuts from one of the sharp equipment, 2 was vehicles that had bust tyre, and the remaining one the worker tripped and fell as result of slippery floor.

The low level of accidents as indicated by the workers in the cause of operating equipment can be attributed to the fact that workers were mostly trained and assessed after the training before fully given the chance to operate equipment. This was revealed from data gathered where about 75% of the workers pointed out that they were given training regarding the use of the equipment and 89% of those trained were assessed before handing of equipment to use.

The initial training of the workers on the use of the

equipment was not the only training given to the workers. About 88.1% of the workers revealed that there are periodic personnel training. Only 11.9% indicated that there have been no further personnel training on the use of equipment after the initial training. Out of the workers who mentioned that there are periodic personnel training, about 27.1% each stated that they undertake personnel training once every three months and once in more than a year. The remaining 33.9% are taken through personnel training on equipment use once very year (refer to figure 1 below). Such periodic training given to workers is a contributing factor to the low rate of accidents as reported by the workers.

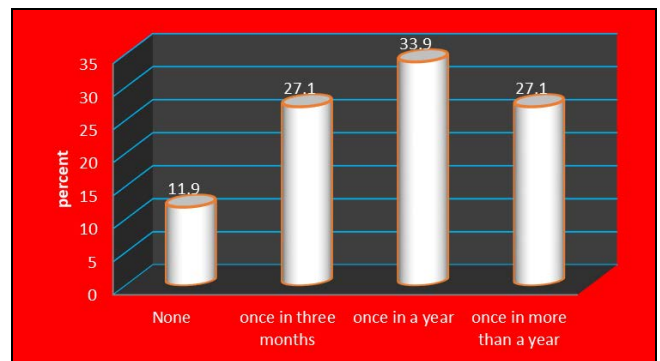


Fig 1: Period of personnel training on use of equipment

Furthermore, the low accident rates in the use of equipment can also be attributed to the high rate of access and usage of personal protective equipment. Thus, the study observed that about 89.2% of the workers interviewed had the required personal protective equipment and 95% of them use it regularly in undertaking their duties. This presented in the figure 2 below

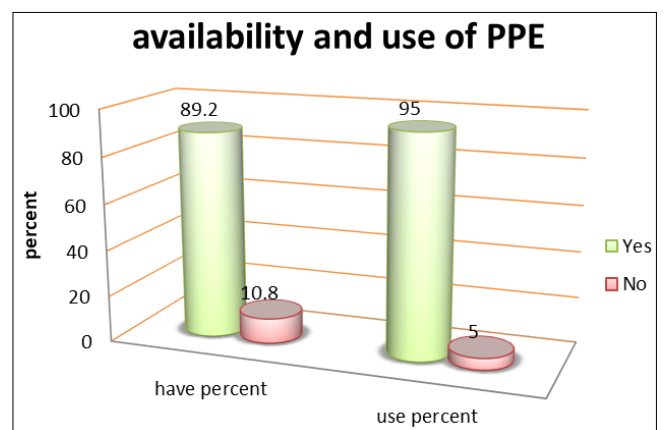


Fig 2: Availability and use of PPE

Occurrence of the Accidents

Focusing analysis on the types of accidents that occurred for period under consideration, cuts is observed to be the most frequent accidents that occur. This observation is confirmed by data gathered as majority of the workers who have had accidents were cuts from sharp parts of equipment. Following cuts in terms of frequency of occurrence is trips and fall, and then dislocation. Sprain is the least occurred accident among the types of accidents. It occurred only once in 2012. The table 2 presents the number of accidents classified under the various types of accidents for the period 2003 to 2018.

Table 2: Number of accidents for the various types of accidents for the period 2003 to 2018

year	cuts	dislocation	fatality	fracture	laceration	puncture wounds	sprain	trips/falls	vehicle	hits	forklift	chemical burns	cargo damages	Environmental pollution/spillage
2003	17	9	0	9	9	4	0	4	0	0	0	0	0	0
2004	3	3	6	11	0	3	0	37	3	0	0	0	0	0
2005	39	9	9	0	0	0	0	9	0	0	0	0	0	0
2006	47	15	3	15	0	0	0	15	0	0	0	0	0	0
2007	25	8	1	8	0	0	0	0	0	0	0	0	0	0
2008	37	13	1	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2010	25	0	1	0	0	1	0	42	3	22	0	0	0	0
2011	30	1	3	1	2	3	0	53	3	26	3	0	0	0
2012	25	1	5	1	2	2	1	50	1	0	1	1	14	0
2013	17	1	4	1	0	0	0	4	1	0	1	2	0	0
2014	4	2	4	0	0	0	0	1	23	0	6	2	1	5
2015	4	8	1	0	0	0	0	2	23	0	14	1	6	2
2016		1	0	0	0	0	0	0	0	0	0	0	1	1
2017	3	2	3	0	0	0	0	0	8	0	5	0	6	1
2018	4	4	1	0	0	0	0	0	1	0	1	1	4	
total	280	77	43	46	13	13	1	217	66	48	31	7	32	9

Source: GPHA, 2019

Deployment of Equipment

Data gathered revealed that equipment needed for operations are easily accessible most especially when a department or a worker has requested for use or is assigned to use the equipment for operation. One of the heads had this to say;

‘Requests are put forth by the user department upon which equipment are supplied. We also ensure a number of equipment is always available for the task operation unit’.

The claim of the heads on the accessibility of equipment was confirmed by almost all the respondent workers. Thus, about 95% out of the total workers interviewed made statements similar to that of the heads. For instance, one worker from the marine engineering department stated that; *‘Operation equipment are accessible if you have been allocated to work with it either during the day or the night shift’.*

Another worker from the stevedoring department also said this;

‘The equipment are accessible after an operator have been given the green light to work at the operations department whenever there is a vessel’.

Observing safety procedures

With regards to safety procedures that operators were expected to go through were duly done as data from interviews revealed. Interview with heads disclosed that operators of equipment are taken through routine training on safety measures and are also encourage to regularly use their personal protective equipment. This is revealed in the words of the heads of departments and the workers that were interviewed. The head at the marine operation stated that;

‘In the event of loading jute sacks, workers are thought to wear nose mask and protective eye goggles’.

A senior staff at the logistics department mentioned that as part of safety procedures

‘An operator does pre-operational checks of the machine before using the machine and post-operation checks after the close of work’.

One other worker stated that as part of the safety procedures *‘one has to be in reflective jacket and safety shoes, do daily checks on the machine (e.g. engine oil, hydraulic, radiator tank, water level etc.), and check if the equipment is in good condition before proceeding to the allocated job side’.*

Therefore, based on what is said by workers and their heads of departments, it can be concluded that safety measures are observed when operating the equipment.

Understanding of Safety Symbols

This stems from the fact that majority of the workers agreed to having marks and signals that serve as communication with safety around their area operation. Thus the table 3 shows that about 70% of the workers have marks and signals that serve as communication language in their area of operation. Only a few of the workers that is 30% indicated there are no marks and signals at their area of operation. These few may be workers whose major tasks are based in the office environment, although this was not information sought from the interviews.

Table 3: Safety marks at area of operation

	frequency	percent
Yes	42	70
No	18	30

Number of workers in a group

In an attempt to understand the work schedule of workers at the port, questions were asked regarding the number of workers in a gang and the standard number of hours worker work. From figure 4, it observed that workers are made to work in groups of four and above. More than half (50.1%) of the workers work in groups made of 7 to 9 members and this was followed by groups made up of 10 or more members. This work group recorded 38.1% of the respondents being in such work groups. Only about 11.1% are in work groups made up of 4 to 6 members.

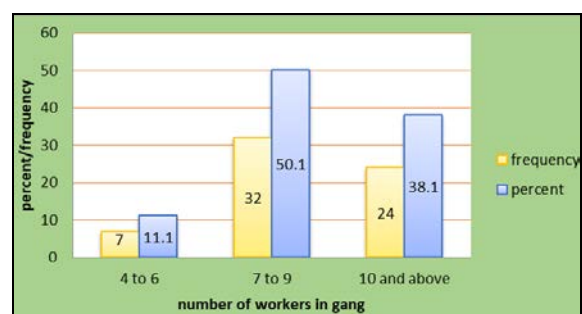


Fig 4: Number of workers in a group

Working hours for equipment operators

The respondents also revealed that their working hours is mostly eight hours. Thus, 59.7% indicated that their standard working hours is eight hours followed 16% of the workers who work for six hours. Form the table 4. Only 3.2% of workers work for more than ten hours.

Table 4: Working hours for equipment operators

	Frequency	Percent
4 hours	8	12.9
6 hours	10	16.1
8 hours	37	59.7
10 hours	5	8.1
more than 10 hours	2	3.2

Challenges in the area of operation

Based on the number of members in a gang they work with and their standard working hours, respondents were asked to indicate if their work arrangement is challenge to their performance of duty with modern technology, almost all the workers revealed that they face any challenge in terms of their work schedule.

The only challenge in the area of operation was on the roads and platforms provided for operations. Thus, the workers indicated that the roads are full of potholes and this makes the use of vehicles and other equipment very frustrating and tiring. Further, there were complains of platforms provided for work being old and weak. This is what one worker said; *'The roads in the port and the platform provided for operations are full of potholes and slopes, and there are too much obstacles which are very dangerous for operation'.*

Summary of Findings and conclusion

The analysis from the four main departments indicated that these departments are found to be dominated with literate workforce which in the case of the introduction of new technologies, less funds will be spent in the training of workers to adopt to the changing trends. New technologies in terms of modern equipment such as high speed computers, surveillance cameras, JCB tele truck forklift, Fibre-optic systems, vehicle tracking systems, biometric identification, computerized state of the art cargo handling equipment and multi system vessel discharge are technologies that have been installed at the harbour since the Strategic Port Development Policy which ensures a proper handling of cargo. These systems will also help check and safeguard properties as well as reduce occupational hazards. These technologies also make communication during the line of duty between workers much easier unlike it was previously when workers resorted only to the use of signals and gestures in communication as pointed out by Davis, (2003) [6]. These systems also ensure proper documentation, easy tracking of goods and a much easier retrieval of information concerning items which was likely not the case prior to the introduction of technology. The introduction of these technologies over the years has brought some advantages in the area of record keeping, monitoring, efficiency and effectiveness of work, and safety at work whiles also minimizing the likelihoods of fraudulent activities.

Even though there was still records of accidents after the introduction of technologies in the port operation it could be noted that they were not as a result of the introduction of these new technologies but as a result of some poor safety

measures during duties with which occupational hazard cannot be completely dealt with. The reduction therefore in the accidents recorded after the introduction of the technologies indicates a positive effect of the technologies. The reduction in accidents as pointed by findings of the study can be attributed to the training given to workers and the use of protective equipment. This finding is different from that of Meletiou, (2006) [8] who attributes the reduction in accidents (fatal) to factors such as changes in patterns of employment, with movement away from hazardous industries, economic trends, and implementation of quality management systems. His accession that lower rate of accidents is as a result of higher unemployment cannot be confirmed by this study as data on employment rates do not form part of the focus of the study.

Recommendation

The study recommends that there should be periodic training of personnel training as this will reduce the occurrence of accidents at the port. Also, workers should observe all the safety standards when carrying out their activities.

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