PRODUCTION ERGONOMIC TRENDS AND CHALLENGES IN THE NIGERIAN PRINTING INDUSTRY: A CASE STUDY OF NDAHI PRESS, ZARIA - NIGERIA

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Abstract
The printing industry operates in a dynamic world and can greatly contribute economically to an individual, a partnership or a government establishment. The aim of this study is to ascertain the effects of ergonomics in the Nigerian printing and production processes. Due to the rigorous procedures involved in the stages of printing and the resultant effect on productivity, there is the need to ergonomically study the staff, equipment, and the general working environment with a view to reducing work related stress such as Musculoskeletal Disorders (MSD) and Repeated Stress Injuries (RSI); thereby improving on services more efficiently. This study highlights the opportunity to appreciate the ability of an organization, to apply knowledge about humans, to create high performance work systems that could be effective, profitable, and help in improving healthy workplaces. This paper presents a qualitative research which uses a descriptive approach to align the procedures in achieving the aim of the study. Direct observation and interviews were conducted on the printing press workers to ascertain opinions which drew conclusions showing how ergonomic issues are inherent in the press lifecycle which is likely to exist in several other printing presses. It is recommended that Ndahi Press as well as all other printing organisations in Nigeria should put more focus on production ergonomics by placing it in a more dynamic context to create a broader knowledge base among staff and those in operations especially. Furthermore, the use of alternative and less toxic materials, improved ventilation, leakage control, or protective clothing such as jackets, gloves, helmets among others must be encouraged.

Keywords: Production Ergonomics, Musculoskeletal Disorder, Printing Press

Introduction

Ndahi Press was established twenty years ago in Sabon Gari, Zaria by Dr. Paul Ndahi, a seasoned graphic designer with several years of experience in design, teaching and printing business. He acquired most of his design knowledge from the Department of Industrial Design, Ahmadu Bello University (ABU), Zaria, Department of Printing Technology, Kaduna polytechnic, ABU press and University of Jos printing press. His vast experiences in the printing domain has led him to singularly establish a modern press with modern machines and equipment to meet the various printing challenges around Zaria and its environs.

Due to the rigorous procedures involved in printing processes and the resultant effect on productivity, there is the need to ergonomically study the equipment, staff and the general working environment with a view to reducing work related stress and improving on services more efficiently to clients. The purpose of the study is to communicate the importance of production ergonomics to managers firstly, then operators, product developers and other industry workers. It is also to present additional data that revealed the connection between production ergonomics and efficiency in product quality and delivery in more general terms.

Production Ergonomics

Researches discuss ergonomics as the study of work place and equipment used in production processes.

Other definitions puts ergonomics as issues that relate to the health of a worker within the ambit of his workplace. Almgren and Schaurig (2012) observed that production ergonomics is mostly connected to the health of the personnel and to social expenses, while other factors that might be affected by inadequate ergonomics are seldom taken into consideration. Similarly, Neumann (2004) opined that there is a huge opportunity to study the ability of an organisation to apply knowledge about humans, to create high performance work systems that could be effective, profitable, and healthy workplaces. These two aspects, the human health and the system performance, are central to the research approach of the 'Production Ergonomics' in general. As such, it aims to promote health, efficiency and well-being in employees by designing for safe, satisfying and productive work. Aickin, Lusted and McPhee (2009) remarked that good ergonomics in the workplace can improve productivity and morale of workers and decrease injuries, sick leave, staff turnover and absenteeism.

Although several industries now largely depend on computerized and automated production processes, many still engage in the injection of manual labour in the course of production. Manual handling in printing procedures often inflict injuries and gradually stresses workers. Workers may sustain injuries such as blisters in the use of hand equipment, strain from fingers while typing, body pains and musculoskeletal disorders (MSD) and this may eventually lead to a decreased production in the long run. Similarly, Pascarelli (2009) highlighted that Repetitive Stress Injury (RSI) is another form of work related injury among others which occur when tasks are performed under strenuous and awkward positions, using postures and poorly designed equipment. Symptoms of RSI vary, but they are roughly divided into three categories namely: Muscle Injury, Tendon Injury (*tendinitis or tenosynovitis)* and Nerve Injury *spondylosis, radiculopathy, also cubital tunnel* (ulnar nerve), *radial tunnel* (radial nerve), and *carpal tunnel* (median nerve). These symptoms may begin slowly over time, but they usually disappear with rest.

Preventing Repetitive Stress Injuries relies basically on changes in work style, pacing, conditioning, and training. Sustained keyboard and production line work can lead to a round-shouldered posture with the neck thrust forward. This posture can damage nerves and weaken the shoulder and upper back muscles and poorly designed tools can cause similar problems (Cheremisinoff, 2000).

Garg (2009) asserts that in the United States, about 6.5 of every 100 full-time workers in private industry experience a work-related injury or illness annually. Although most of these incidents are minor, approximately 2.8 million cases each year involve loss of work time, and about 6,000 American workers die each year because of work-related injuries or accidents. Only with the passage of the Workmen's Compensation Laws and related labour statutes between 1908 and 1948 did employers start to pay attention to industrial safety; making the work environment safer was less costly than paying compensation. Gwari (2016) agreeing with Garg (2009) remarked that various external sources, such as chemical hazards and substances like solvents, paints, dye stuffs, irritating gas, mist, and dust in the studio

also cause work-related injury. Biological or physical hazards may also result from the interaction between worker and environment; these so-called ergonomic hazards can cause physiological or psychological stress. Biological hazards arise from bacteria or viruses transmitted by animals or unclean equipment and tend to occur primarily in the food-processing industry, while common physical hazards include ambient heat, burns, noise, vibration, sudden pressure changes, radiation, industrial accidents, electric shock as well as repetitive muscle and stress related injuries. Industrial safety engineers attempt to eliminate hazards at their source or to reduce their intensity. If this is impossible, workers are required to wear protective equipment as shown in Plate I. Depending on the hazard, this equipment may include safety glasses, earplugs or earmuffs, face masks, heat or radiation protection suits, boots, gloves, and helmets. To be effective, however, the protective equipment must be appropriate, properly maintained, and worn by the worker.

Plate I: Maintaining Safety at Work Place, Source: Graves (1999) http://www.encyclopedia.com/literature-and-arts

Systems Approach Safety

In recent years engineers have attempted to develop a systems approach known as safety engineering to industrial accident prevention. Because accidents arise from the interaction of workers and their work environments, both must be carefully examined to reduce the risk of injury (Nolan, 1996). Injury can result from poor working conditions, the use of improperly designed equipment and tools, fatigue, distraction, lack of skill, and risk taking. The systems approach examines the following areas: all work locations to eliminate or control hazards, operating methods and practices, and the training of employees and supervisors. Key facts about accidents and injuries are recorded, along with the history of the worker involved, to check for and eliminate any patterns that might lead to hazards.

In occupational ergonomics it is necessary to examine not only the physical design aspects of work or the 'hardware', but also areas such as work organisation and task design, job content and control over workload, support and training. The social and managerial environment is important. Usually these aspects require ergonomics to be integrated into the broader work systems. Such problems can be avoided by good

workplace design and by good working practices. Prevention is easiest if action is taken early through effective analysis of each workstation.

Body positioning and the positioning of equipment are fundamental to ensuring a comfortable and healthy interaction with computers. The image on Figure 1 helps to suggest a means to reducing the risk of such health problems: Sit up straight rather than slouch forward (Graves, 1999).

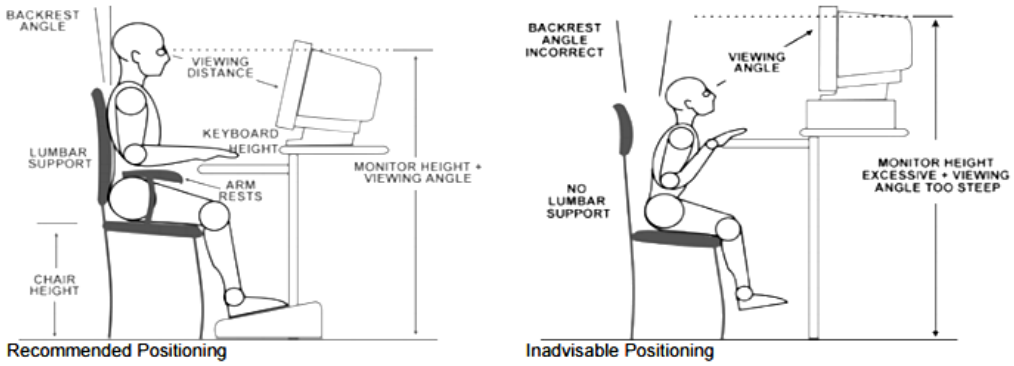

Figure 1: Recommended and Inadvisable Positioning, Source: National Centre for Technology in Education

Arranging a Safe Working Environment

Work stations in printing and other industries should be comfortable and have sufficient space to allow for freedom of movement. Graves (1999) observed that adequate space between workstations should be provided for users in classrooms, studios and computer suite context. This should exclude space taken up by fixtures such as presses and filing cabinets. As computers can generate heat, a well-ventilated room is an important consideration. Coiled cables also give off heat and may need to be rerouted.

Ergonomics in the Printing Industry

The printing industry has the potentials of driving any economy a great deal. It has been observed that Alberta Press was the fourth largest in the Canadian industrial sector (Scott *et al*, 2009). The nature of customer needs and the market place means the printing industry cannot afford downtime or loss costs associated with property loss, equipment failure, accidents and injuries, and omissions in producing and delivering products to customers as at when due. Accuracy, quality and timeliness are key measures by which customers judge the reliability of a printing press and decide whether or not to continue to do business with it or not. Workers in the printing industry are also exposed to ergonomic situations such as material handling and repetitive motion, exposure to dyes, chemicals, inks, paints and solvents. Material handling can be from raw materials such as rolled and sheet of paper, finished products. Repetitive motion can come from bindery and mailing operations (https://www.ceiwc.com). Printing Industries constantly require higher production rates and developments in state-of-the-arts technology to remain competitive and stay in business. As a result, jobs today can involve frequent lifting, carrying, and pushing or pulling loads without help from other workers or devices, increasing specialization that requires the worker to perform only one function or movement for a long period of time or day after day, working more than 8 hours a

day, working at a quicker pace, such as faster assembly line speeds and having tighter grips when using tools. These factors—especially if coupled with poor machine design, tool, and workplace design or the use of improper tools—create physical stress on workers' bodies, which can lead to injury. Recognizing ergonomic risk factors in the workplace is an essential first step in correcting hazards and improving worker protection. Ergonomists, industrial engineers, occupational safety and health professionals, and other trained individuals believe that reducing physical stress in the workplace could eliminate up to half of the serious injuries each year and employers can learn to anticipate what might go wrong and alter tools and the work environment. Also, savings can be drawn from investments in production ergonomics in the long run. This, in turn, may hopefully result in an increased interest and involvement of the management and hence production ergonomics can get more attention in the long run in Nigeria especially.

Methodology

This study is a qualitative research which uses a descriptive approach to lay down the procedures in achieving the aim of the study. Direct observation, interviews and interactions were made for collecting data for the study. Since the number of staff at Ndahi Press is not very large, all of them were included in the study based on availability to ascertain opinions and conclusions that focus on production ergonomics.

Results and Discussion

Results from interviews and direct observation at Ndahi Press showed that ergonomic issues are inherent in the press and it is very likely to exist in some other printing press as well. The subsequent set of images show series of work in progress within the various stages in a printing cycle (Prepress, Press and Post Press) at the case study area.

Much of the printing jobs carried out in the press are lithographic in nature. In this stage of the press processes, the ergonomic incidences are largely related to the posture of standing while inking the roller drums unlike in the prepress stage where strain and stress are usually from wrists and fingers. In the course of observation, Aickin, *et al*. (2009) proposed a model in recommending good postures at work stations and inadvisable postures which may lead to strain or long time injuries (Figure 1). The observed postures by workers compared to the varying postures by operators in the prepress, press and post-press stages of the printing cycle do not conform to the recommended modes (Plates II and III). There is therefore the need to construct or acquire adjustable desks and furniture to suit the needs of the user as recommended.

Plate II: Design Stage (Pre-press)

Plate III: Design Stage (Pre-press)

Source: Original photograph snapped by Bonaventure Zirra (2016), enhanced by Peter Sale (2017).

In plates II and III, the sitting position does not conform to the gleaned literary sources as recommended earlier in Figure 2 and interviews with the computer operators revealed that they sometimes suffer from back aches from time to time.

Plate IV: Printing Stage (Kord) **Plate V: Printing Stage (Digital)**

Source: Original Photograph Snapped by Bonaventure Zirra (2016), enhanced by Peter Sale (2017).

In the press stage, operators gave insight on ergonomic challenges, noting that because of the size of the machines they have to be constantly busy moving back and forth and side to side to monitor the entire printing process. As such, operators complain of general body pains due to the tedious process of machine handling and operations. Due to the advancement in technology, the operations come much easier using the digital Direct Imaging (DI) machine as depicted on plate IV.

Plate VI: Laminating Stage

Plate VII: Trimming Stage (Post-press)

Source: Original Photograph Snapped by Bonaventure Zirra (2016), enhanced by Peter Sale (2017).

If the physical, psychological, or environmental demands on workers exceed their capabilities, ergonomic hazards may arise. This type of hazard frequently occurs in the area of materials handling, where workers must operate heavy equipment. The post-press stage also has some inherent ergonomic related issues. Although, most of the jobs in this stage are usually done electronically in the sense that the laminating and trimming machines are largely electronic and automated, to a large extent, thereby reducing much of the manual involvement. The process is usually done standing so there are also issues related to aching of the feet when there is much job in the press. A times there are also minor injuries sustained from paper cuts and heat burns from laminating procedures. The final stage of delivery also comes with its own challenges which are usually associated with back aches. The process of loading printed documents involves constant bending and standing postures which results to RSIs over time. The aspect of maintenance is another big challenge because lifting, removing and replacing all machine parts are done painstakingly manually rather than using more sophisticated means of operations.

Plate VIII: Delivery Stage (Post-press)
Source: Original Photograph by Bonaventure Zirra (2016), enhanced by Peter Sale (2017)

By showing the relationship between production ergonomics and the quality outcome, the benefits of ergonomics can be described as decreasing cost of inefficient quality. When the workers are in good health without any much stress or injuries, there is a strong likelihood that productivity will be more efficient. This paper attempts to show printing presses the potentials derived from improving the production ergonomics at the various stages of press productions. It also contributes to the range of studies that present a connection between production ergonomics and factors relating to health as well as social expenses.

Having highlighted the consequences of postures and equipment handling in industries which generally leads to low output, this work seeks to subsequently focus on other categories of printing presses. It will also attempt to search for possible means of improving work stress, related injuries in industries and particularly, in printing industries, thereby saving costs and improving efficiency that can come from improved production ergonomics.

Summary and Conclusion

This study showed that there is a huge opportunity to study the ability of an organisation to apply knowledge about humans and equipment, to create high performance work systems that could be effective, profitable, and healthy. The two major physical aspects involved in ergonomic studies are the human health, and the system performance. This study highlighted the possibilities and limitations that can be expected in the continued work. It is also meant to warrant further investigation concerning production ergonomics in the Nigerian printing industry, a potential for economic growth and sustainability. It is equally important to convey the message to the product development departments, since the design of the product provides the base for the ergonomic situation in the production site. Initiating this project will help to facilitate and draw attention to the area of communication production ergonomics within the field of production designs.

Recommendations

This study recommends the continuation of extensive research in production ergonomics – a fundamental and neglected aspect of an industry life in Nigeria. The study highlights the need to recommend to the management of Ndahi Press to put more focus on production ergonomics by placing it in a more dynamic context to create a broader knowledge base among staff and those in operations especially. Also, management and all stakeholders should establish a mutually acceptable more thorough understanding of ergonomic domain, since it has proven to be a general fact that the employee in printing press often times face work related hazards and thus industry safety must be considered and given the deserved priority.

The study also suggests that a regular routine of physical exercises such as stretching, strengthening, postural training, and isometric and aerobics should be essentially performed at home and in the organization periodically. Graphic designers and computer operators in printing presses should be encouraged to take regular breaks if working for protracted periods on a system. Thus, the use of adjustable furniture and equipment to the correct height, distance and angle is highly recommended at Ndahi press and indeed other Nigerian printing presses.

Hazard elimination in Ndahi Press as all printing presses that use lithography may require the use of alternative and less toxic materials, improved ventilation, leakage control, or protective clothing such as jackets, gloves, helmets among others. While Ndahi Press has here been studied as a case, further exploratory observations as implied in the preceding appear to indicate the need to make more critical analysis of production ergonomics in printing presses of all categories in Nigeria.

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