Contribution ID: **10** Type: **not specified**

APPLICATION OF 3D MODELLING TECHNIQUES FOR THE ERGONOMIC IMPROVEMENT OF A MANUFACTURING ASSEMBLY LINE WORKSTATION

Monday, 21 July 2025 13:05 (15 minutes)

Ergonomic workstation design is critical for improving productivity and occupational health in manufacturing environments. Studies have shown that Assembly Line Workstations (ALW) expose workers to repetitive tasks, prolonged physical exertion, and constrained postures, which increase the risk of musculoskeletal disorders, fatigue, and absenteeism. This study applied 3D modelling and digital human simulation techniques to assess, analyse, and redesign an ALW for ergonomic improvement and worker wellness. A purposive sampling technique was used to select fifty experienced assembly line workers from a manufacturing facility in Nigeria. Data on ergonomic discomfort, task-related fatigue, tool accessibility, and workstation limitations were collected using structured questionnaires and direct observation. The Rapid Upper Limb Assessment (RULA) method was employed to determine ergonomic risk levels, with scores categorised as low (1-2), medium (3-4), high (5-6), and very high (above 7). Fusion 360 software was used for 2D and 3D sketching and modelling the existing ALW. Digital human modelling software (Jack Siemens 8.4) was used to create a virtual redesign using standard anthropometric data from the literature, allowing posture analysis and ergonomic risk assessments in the virtual environment. Findings showed 44% of participants were aged 18-25 years, while 56% were aged 26-35. Participants reported spending 8-12 hours at the workstation. Reported discomfort levels were always (12%), often (8%), sometimes (62%), rarely (10%), and never (8%). Perceived posture comfort levels were: comfortable (4%), slightly comfortable (20%), uncomfortable (40%), and very uncomfortable (36%). Frequent bending was reported by 76% of participants, and 76% also indicated insufficient workspace. Pain was reported in the neck (4%), shoulder (6%), arm (8%), back (40%), wrists (18%), hand (10%), legs (6%), and feet (8%). Tool accessibility was poor, with 86% stating tools were out of reach, leading to postural strain. 90% of workers experienced prolonged discomfort due to poor postures at the existing ALW. The redesigned workstation allowed workers to maintain neutral postures, resulting in a RULA score of 2.0, which indicates low ergonomic risk. Improvements included adjustments to seat height (to match knee-hip ratios), tool reach distances (to optimize access), and working angles (to reduce fatigue and improve posture). This study demonstrates the practical benefits of integrating 3D modelling and digital human simulation in ergonomic workstation design. It highlights the potential to reduce postural hazards, enhance worker comfort, and improve productivity. Organizations are encouraged to adopt digital human modelling tools to create a safe, healthy, and efficient manufacturing environment.

Keywords: Digital human modelling, Workstation design, 3D Modelling, Musculoskeletal disorder, Assembly line workstation

Primary author: Dr MUYIWA, Omotunde (University of Ibadan)

Co-authors: Mr OLALEYE, Emmanuel (University of Ibadan); Dr ORIOLOWO, Kolawole (University of Ibadan)

Presenters: Dr ORIOLOWO, Kolawole (University of Ibadan); Dr MUYIWA, Omotunde (University of Ibadan)

Session Classification: Contributed Talk

Track Classification: Engineering: Mechanical Engineering