Development of Efficient Workstation For an Industrial Assembly Task

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Abstract

Worker productivity improvement is a major concern for management in the manufacturing industry, especially with repetitive assembly tasks. Industrial workstation is considered as the main source of worker productivity, safety and health problems. This project investigated the application of ergonomics in the development of a workstation for an assembly task that would enhance operator performance, health and safety, and satisfaction. The selected task was the assembly of an electrical switch from a local electrical products manufacturing company. The existing assembly workstations and the task method were studied to identify ergonomic problems. Worker performance in terms of normal cycle time to assemble one unit of the product was determined using a stopwatch. The company supplied a workstation that was brought to the ergonomics lab for detailed analysis. A Methods- Time Measurement (MTM) analysis was conducted to determine the cycle time. Based on the analysis, a new ergonomically designed workstation was modeled using Ergonomic Layout and Optimization of Manufacturing Systems (ERGOMAS) software. An optimum design was achieved considering the working population anthropometry. The ergonomic assembly workstation was fabricated in the university workshop and brought to the company for experimentation. Three experimental conditions were studied in the company with ten industrial workers: (1) existing workstation, assembling one unit per cycle, (2) ergonomically designed workstation, assembling one unit per cycle, and (3) ergonomically designed workstation, assembling five units per cycle (5 units in a batch). Data were collected on ten cycle times per worker in each experimental condition. A satisfaction questionnaire was administered before and after the intervention. The data were then summarized and analyzed using SPSS. The results showed that the ergonomically designed workstation and method for performing the assembly task had a highly significant positive effect on reducing the cycle time of the task performance and increasing worker satisfaction. The reduction in the mean cycle time was 27% in the ergonomically designed workstation and method assembling one unit per cycle
compared to the existing workstation condition. Stated otherwise, operator performance was improved by 27%. A further reduction in the cycle time was achieved on the ergonomically designed workstation condition assembling five units per cycle. The reduction was 43% compared to the existing workstation condition. In other words, the operator performance was improved by 43%. Worker satisfaction with regard to workstation was improved by 45%, from an average score of 3.1 in the existing workstation to an average score of 4.5 in the ergonomically designed workstation. Worker satisfactions with task and health attributes were improved by 46% and 33%, respectively, in the ergonomically designed workstation. Higher worker productivity and satisfaction were due to incorporation of ergonomic principles and data in the design of the workstation and task. Major changes incorporated in the new workstation and task were: (1) flexible posture in the task performance, (2) adjustable and comfortable seating arrangement, (3) work and seat heights adjustment, (4) workplace layout in the normal and within the maximum work areas, and (5) adjustable incoming and outgoing bins and proper hand tools. By incorporating these features in the design of the new workstation and task made the work more comfortable, less fatiguing and more efficient.

The investigation showed that an efficient workstation for assembly operation is possible through the application of ergonomic principles and data. This enhanced worker performance and satisfaction. An ergonomically designed workstation can also eliminate occupational health and safety problems. This type of research will have immense implications for industrial managers who are interested in improving worker productivity, health and safety, and satisfaction in manufacturing industry engaged in repetitive assembly tasks.