DEVELOPMENT OF HEIGHT AND REACH APPROPRIATE WORKSTATIONS

A Term Project

Presented

to

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California State University Dominquez Hills

In Partial Fulfillment

of Course Requirements for

Human Factors Engineering

QAS-515

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by

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SCOPE

Developing height and reach appropriate workstations for injection molding presses based upon current employee population data.

BACKGROUND

This project focuses on analyzing population data from employees of an injection molding facility in order to develop workstations that are height and reach appropriate.

The company began operations in 1992 as a small injection molding operation with four presses. Over the past sixteen years the company has grow in size and has added twenty-two additional presses. Historically, the company has never had an industrial engineering to develop effective workstations.

Like many small companies, this organization relied heavily upon the maintenance department to fabricate workstations for presses throughout the years. Subsequently, the workstations that have been fabricated are of varying heights and designs.

The organization has no design standard for the fabrication of workstations and uses the maintenance departments “best guess” at developing the workstation tables. This approach has resulted in measurement of existing workstations and reproducing to the same or like dimensions.

The organization has experienced a handful workers compensation claims over the past three years. A review of these claims will be conducted to determine if the injuries are attributed to the current workstation designs or lack thereof.

The project requires collection of data from human subjects. The subjects were informed that the author was investigating new ideals for workstations and consent was received from the subjects.

EMPLOYEE SAMPLE POPULATION DATA

Sample population data was gathered from fifty-two employees of varying heights, weight, sex and nationality. This study focused on the height and reach of the employee sample population.

To accurately gage the height of the subjects, a Seca 242 Digital Stadiometer was utilized and the subjects were measured without footwear. The Seca 242 provides readouts in both english and metric values.

Reach data was gauged in a somewhat less sophisticated manner. A tape measure was utilized to measure the length of the arm perpendicular to the erect body. The subjects placed their backs against a wall and a measurement was taken from the wall to end of their middle finger. For the purpose of this study, all data is being reported in metric values to coincide with data presented in the course textbook.

Data from male subjects indicated an average height of 179.2 with a max of 184 and min of 174. Reach data for the same male subjects indicted an average reach of 75.8 with a max of 80 and min of 70.

Data from female subjects indicated an average height of 168.6 with a max of 175 and min of 162. Reach data for the same female subjects indicated an average reach of 73.7 with a max of 77 and a min of 69.

Data from the combined male and female subjects indicated an average height of 173.9 with a max of 184 and a min of 162. Reach data from the combine male and female subjects indicated an average of 74.7 with a max of 80 and a min of 69.

CURRENT WORKSTATION DESIGN

The current workstation design consists of an operator being stationed at the end of an injection molding press. Components are ejected from the mold onto a conveyor which feeds parts to a stationary workstation table. The operator then grabs the parts, performs a visual inspection and packs the part into either a returnable tote or various expendable corrugated boxes. There are thirty workstation tables available for use at the twenty-six presses. The tables range from a height of 99 to 114cm and a width of 66 to 91cm. Some, but not all, of the tables can be adjusted by the maintenance department for height by removing eight bolts and adjusting the sub legs; however, none of the tables can be adjusted for width. None of the tables can be adjusted by the operator that uses them.

PAST OSHA RECORDABLE INCIDENTS RELATED TO CURRENT DESIGN

A thorough review of all OSHA recordable incidents was conducted as part of this project. Over the past three years, the organization has had fourteen recordable OSHA incidents, of which six resulted in claims being filed with the organizations workers compensation insurance carrier. At least one workers compensation claim is directly attributed to work station design, particular work table height.

The claim attributed to the work table height dealt with a 43 year-old female that stood 147cm in height and was working at workstation with a table that was 101cm in height. Due to the employee's stature versus the height of the table, the employee was given a stool to stand on by her immediate supervisor in order to perform her job duties. As a result of standing on the stool, the employee fell backwards and landed on a concrete floor. The fall resulted in the employee breaking her pelvis and required orthopedic surgery to repair and extensive rehabilitation thereafter. The total cost of this injury, including time off of work and medical bills, was approximately $211,000. This injury also caused a negative change in the organizations mod rating which in turn caused the organizations worker's compensation premium to increase by 342%.

It is unclear, by the documentation on file, if the organization implemented any effective countermeasures to prevent the reoccurrence of this issue.

REVIEW OF POSSIBLE NEW DESIGNS BASED UPON CURRENT EMPLOYEE POPULATION DATA

Based upon the employee sample population data, it is recommended that adjustable height workstation tables be adopted by the organization. The current range of height between male and female workers is 22cm or roughly 8 inches. Taken into account that the organization has previously had employees that were 147cm in height this would cause an even greater range in possible heights. The disparity in employee heights would not make it feasible or practical to have non-adjustable workstations of various heights.

Several possible designs were consider from manual hand crack systems to pneumatic lift systems. Although less expensive, hand crack systems introduce another potential for employee injury especially if the table is difficult to crank. The hand crank system also would require more time and effort by the employee to either raise the table up or down thereby taking time away from production activities.

The width of the table should be standardize and be a minimum of 38cm and a maximum of 61cm to safely accommodate the needed ranges of the workers.

Whether the organization decides on manual, electrical, or pneumatic lift workstation systems, it is imperative that the workers and supervisors be trained in the proper height position of workstations. If the organization does not provide this training, they are then putting workers into a position of changing workstation heights without knowing the proper height levels based upon their particular physical characteristics. The tops of workstations ideally should allow for the workers arms to rest easily at 90º. A simple tool to calculate the ideal height of a workstation can be found at http://internalapps.ergotron.com/MirWebTool/ergoTool_USunits.html. Alternatively, a

chart should be developed to aid the worker in proper calculation of workstation height and posted at each workstation in the organization.

Hand Crank Workstation w/o Light

Hand Crank Workstation w/ Light

Electric Lift Workstation w/o Light

Electric Lift Workstation w/ Light

An analysis of the cost of the pre-fabricated manual crank workstations versus the cost of fabricating the current workstations within the organization indicated no significant cost increase. This analysis was based upon the cost of materials, freight, and labor to manufacture the workstations. The cost to replace all twenty-six workstations with manual crank workstations is approximately $14,300.

The cost of the electric lift workstations is significant more than the manual crank version. The total cost to replace all twenty-six workstations with electric lift workstations is approximately $23,000 for workstations without task lights and $27,300 for workstations with task lights.

Although the cost of the electric lift workstations is significantly higher, the benefits far outweigh the risk of additional injuries that may be caused by repetitive motion of cranking the manual table. Therefore, it is this author's recommendation that the electric lift workstations be implemented throughout the organization.

COST SAVINGS AS A RESULT OF NEW DESIGN

If the new design prevents just one additional occurrence of worker injury similar to the occurrence previously discussed, then the cost savings is astronomical. Since no effective counter measures have been put in place since this occurrence, the likelihood of reoccurrence is great.

In addition, this improvement activity should weigh heavily on our workers compensation insurance carrier resulting in a decrease in premiums. Any potential decrease in premiums would offset the initial cost of implementation.

Additional cost savings as a result of productivity and quality improvements will be discussed in the following section.

PRODUCTIVITY AND QUALITY IMPROVEMENT RELATED TO NEW DESIGN

The new design will reduce or remove stress on the worker whereby making the task easier to perform. With the task being easier to perform, one could surmise that productivity improvements should be noticeable. With increased productivity, the organization now can focus on loading the employee with additional work, such as running three machines versus two machines. Additional studies will need to be conducted to validate this theory.

With the physical stress being reduced or removed, the employee fatigue level will decrease. This reduction in fatigue should allow for the employee to better focus attention on the visual inspection of parts for cosmetic blemishes thus improving the quality output. The improved quality output should have an effect on the customer's perception of the organization for the better.

With the improve perception of quality by the customer, the organization is more likely to receive additional contracts from the customer. This improved perception will allow for the organization to be in a better position with respect to negotiating price and terms with the customer.

SUMMARY

In conclusion, the current design of workstation is unsafe and has resulted in significant cost to the organization due an employee claim. Productivity and quality is directly affected by the workstation design, whereby placing additional unnecessary cost on the company. With minimal investment, the organization can transition from a “one size fits all” design to a design that allows for the workstation to be adjusted based up the height of the employee manning the press. The cost of this improvement activity will be recouped by productivity and quality enhancements.

APPENDIX I

Sample population data from the employee population as of February 18, 2008.

Sex	Height (cm)	Reach (cm)	Sex	Height (cm)	Reach (cm)
Female	167	73	Male	185	79
Female	172	75	Male	180	78
Female	170	74	Male	178	77
Female	172	75	Male	179	77
Female	169	75	Male	182	76
Female	171	77	Male	184	78
Female	165	72	Male	179	76
Female	169	76	Male	177	73
Female	173	76	Male	178	75
Female	172	74	Male	178	73
Female	170	71	Male	181	78
Female	175	76	Male	177	75
Female	169	74	Male	174	70
Female	166	72	Male	175	73
Female	170	75	Male	180	78
Female	163	70	Male	176	75
Female	171	75	Male	183	78
Female	171	77	Male	182	77
Female	165	71	Male	177	76
Female	167	73	Male	180	77
Female	163	71	Male	181	77
Female	164	73	Male	181	75
Female	174	77	Male	183	80
Female	167	72	Male	176	73
Female	162	69	Male	179	77
Female	171	76	Male	180	77
Min	162	69	Min	174	70
Max	175	77	Max	184	80
Average	168.65	73.78	Average	179.2	75.82

Combined Statistics (F&M)

Min	162	69
Max	184	80
Average	173.9	74.7