Using a continuous improvement tool to improve workers' well-being and productivity

A case study in a piglet cutting workstation

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***Abstract*— Nowadays there is an increasing concern for well-being. However, workers continue to suffer from musculoskeletal disorders, which are one of the most widely recognized types of occupational disease. Meat cutters face higher risks of injury and musculoskeletal problems than most other occupational groups due to repetition, force, static posture, work organization, and lack of recovery time. The aim of this paper is to use a continuous improvement audit tool to analyze the current situation of a piglet cutting workstation and then identify measures to improve it, considering productivity and workers' well-being.**

Keywords—worker well-being; ergonomics; Work-Related Musculoskeletal Disorders; productivity; meat-cutting; continuous improvement

I. INTRODUCTION

These days, there is extreme pressure for businesses to be competitive in their markets of choice [1]. This seems, however, to be impacting workers' well-being in a negative way. According to [2], a risk of injury, illness and death is associated with work. Not only are there dangers associated with traditional occupational health hazards, an example of which being physically dangerous workplaces, but work can also be a contributor to health conditions with several other origins, such as unhealthy lifestyles, psychological conditions and chronic disease. While work can have a negative impact on health, the reverse is also true. Lack of good health can lead to more frequent disability, absenteeism and low production on the part of workers, which therefore means these workers will need more access to health care resources than their healthy counterparts. Workers, employers and society pay the costs of a poor workforce. Thus, having the safest, healthiest and most productive workforce attainable makes sense from both a business and a humanitarian standpoint. [2]. One of the most widely-spread kinds of occupational disease, in Portugal and in Europe, is work-related musculoskeletal disorders (WMSD). Because of this, European research is focusing on WMSD prevention by 2020 [3]. This paper focuses on one of the occupational groups with the highest risk of injury and musculoskeletal problems: meat cutters [4]. The activities of these workers carry several WMSD risk factors, which include repetition, force, static posture, low temperature, work organization and limited recovery time [4]. [5] and [6] have demonstrated high wrist speed and strength, common WMSD risk factors, are demanded from meat cutters, whether in line work or single stations.

The aim of this paper is to use a continuous improvement audit tool to analyze the current situation of a piglet cutting workstation and then identify measures to improve it, considering productivity and workers' well-being.

The consumption of piglet meat is very popular in Portugal, mainly in the central zone of the country where are

dozens of restaurants dedicated to serve this type of meat. This type of meat is also sold, already cooked, as a take away service, especially during festive dates along the year.

In addition to the ergonomic problems, restaurant managers are faced with the challenge of increasing productivity while not being able to extend the period of the cutting process (11:00 to 15:00 and 19:00 to 23:00), due to the fact that the meat must be cut while hot.

II. Methods

The methodology used was the case study. According to [6], a case study should be defined "...as a research strategy, an empirical inquiry that investigates a phenomenon within its real-life context." Following this key idea, the case study, as a research methodology, helps to understand, explore or describe a given system/problem in which several factors are simultaneously involved, in a real context.

To achieve the aim of this paper, the current situation of the piglet cutting process was analyzed by a multifunctional team, including workers. Firstly, the team used a continuous improvement tool, which was developed by the authors, and then the Rapid Upper Limb Assessment (RULA) tool was used to evaluate the ergonomic situation. In the end, improvement solutions were presented.

A. *Continuous Improvement Tool*

The audit tool has a checklist format with 72 evaluation questions divided into 9 sections: efficiency, continuous improvement, safety, standards, visual management, process and operations, material flow, zero defects, ergonomics and discipline. Some of the questions are described below:

- Have there been any work accidents in the last 6 months?
- Are there any workers with occupational diseases associated with tasks performed at the workstations/production area under analysis?
- Do all workers feel responsible for continuous improvement, actively and participate frequently (more than once every 6 months) in giving ideas for it?
- Are workers aware of the existence of risk and are they informed about how to protect themselves and avoid health problems (assess whether workers have been trained in safety, use of EPI's, ergonomic postures, etc.)?
- Does the operation(s) involve a risk of accidents (eg: work tool slippery or difficult to grasp, etc.)?
- Are there all standards documents required in the production area in place (work instructions, cleaning plan, maintenance plan, scheduling matrix, polyvalence matrix, reaction limits, 5S audits, etc.)?
- Is there any waste related to waiting times, transportation or moving?
- Does the worker adopt an essentially static posture?
- Is effort repeated continuously for at least an hour?
- Does the work plan provide breaks for rest? If so, are they long enough to allow for a fully recovery?
- Does the work plan seem too high or too low for the worker?

The questions were answered by the management together with the workers in the form of: yes, no and not applicable (NA).

B. *RULA (Rapid Upper Limb Assessment) tool*

The RULA as the tool used to assess the postures, movements and forces exerted by the worker while performing the job, because it is especially useful for scenarios in which work-related upper limb disorders are reported. The higher the RULA score - varies from 1 to 7, defining the action level to be taken- the higher risk associated and the greater the urgency to carry out a more detailed study and introduce modifications to the job/workstation. The scores 1 and 2 (action level 1) indicates that the posture is acceptable if it is not maintained or repeated for long periods of time. The scores 3 and 4 (action level 2) indicates that further investigation is needed. The scores 5 and 6 (action level 3) indicates that changes are required soon. The score 7 or more indicates that changes are required immediately [8].

Fig. 1 depicts the RULA score interpretation.

Score	Level of MSD Risk
1-2	Acceptable posture, if it is not maintained for long time
3-4	Further investigation is needed and changes may be required
5-6	Investigation and changes are required soon
6+	Investigation and changes are required immediately

Fig. 1. RULA score interpretation

III. Results and Discussion

A. *Current Situation Analysis*

According to the audit results, the key aspects that should be enhanced were: continuous improvement, safety, visual management, process and work organization, and ergonomics.

Fig. 2 depicts these results. The blue line represents the current score, the green line represents the target and the red line represents the current average.

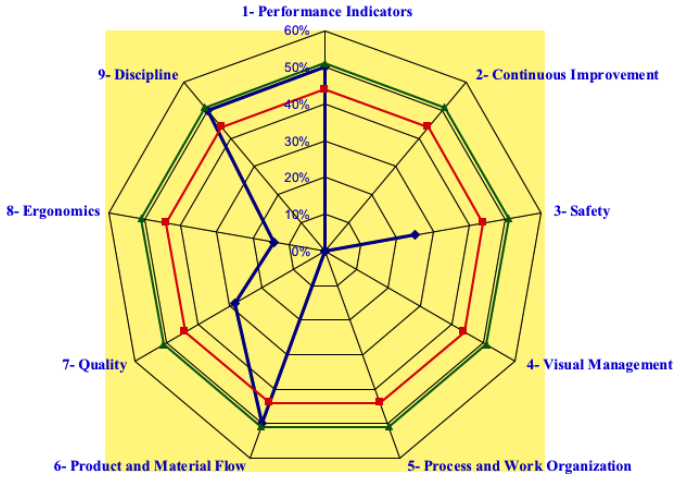

Fig. 2. Results of the assessment tool application in the case study - before intervention

These results were expected, since this area has never been the target of improvement actions and there are no standards or any kind of visual management. However, the most urgent areas of improvement should be safety and ergonomics, as safety and worker well-being must be a priority during improvement actions.

Fig. 3 shows the hands of the worker during the meat cutting process. One of the safety-failure problems identified by the team was the lack of safety gloves, an individual safety protection measure that should be implemented in this type of tasks. In the image it is also possible to note the force required to perform the task as well as the awkward hand posture.

Fig. 3. Cutting process

Being a very repetitive task, which requires force and a static position to perform, workers complaints due to lumbar, wrist and shoulder pain are increasing.

Furthermore, some workers suffer from occupational diseases caused by performing this work.

The next step was to assess the workers' postures and evaluate the risk of having musculoskeletal disorders during the meat-cutting process.

B. Ergonomic Analysis

The RULA ergonomic assessment tool considers biomechanical and postural load requirements of job tasks/demands on the neck, trunk and upper extremities. A single page worksheet was used to evaluate required body posture, force, and repetition. Based on the evaluations, scores were entered for each body region in section A for the arm and wrist, and section B for the neck and trunk.

Raised shoulders, abducted upper arms, twisted wrists, static posture, repeated actions and twisted trunk were some of the issues that penalized the final score, which was 7. According to this method "investigation and changes are required immediately".

Fig. 4 presents some of the awkward postures adopted by the worker during the meat cutting process.

Fig. 4. Awkward postures adopted by the workers during the meat cutting process

At the end of this analysis, the team identified that the priority would be the implementation of measures to improve the well-being of workers by changing the cutting process or by the re-organization of the work. This conclusion matches the results of the continuous improvement tool, whose score was less positive in the ergonomics, safety and process and work organization sections.

The next step was to gather the team with the goal of finding an ergonomic and safety improvement solution and, at the same time, if possible, an increase in productivity.

C. Improvement Solutions

The solutions found by the team took into account several requirements, such as not damaging the meat and cutting it while hot.

The final appearance should be identical to Fig. 5.

Fig. 5. Final appearance of the cut piglet.

Taking into account the safety of the workers, the first immediate measure proposed by the team was the use of safety gloves. After a brief anthropometric analysis the team proposed adjusting the work plan, which is currently very low and forces the worker to acquire awkward positions. Other measures given by the team were improving lighting and increasing the frequency with which the scissors are sharpened, in order to reduce the effort made by the workers during the cutting process.

Another measure proposed to improve workers' well-being and reduce the risk of musculoskeletal disorders was the introduction of breaks during the cutting periods. However, the manager rejected this idea because it would decrease the output leading to losses in sales. Taking that, the short periods devoted to cutting and the requirement of cutting the piglet while hot into account, the optimized solution given by the team was the automation of the process. This solution would eliminate the workers' WMSD risk, improve their well-being and productivity quintupling.

The machine design took into account an anthropometric analysis.

Fig. 6 and 7 show some details of the machine designed by the team for the meat-cutting process.

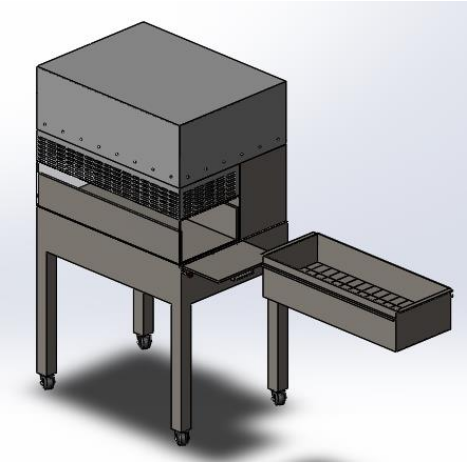

Figure 6. Front view of the machine

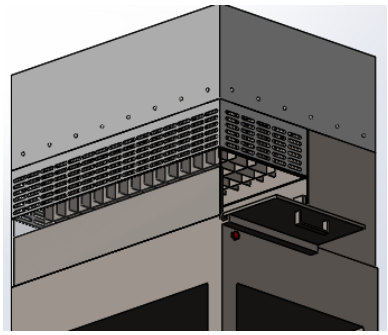

Fig. 7. Detail of the cutting blades

The solution is still in project mode. The next step will be to produce the model for testing.

D. Final Discussion

Beyond the measures proposed by the team, continuous improvement should also be introduced in this area, by the definition of performance indicators and objectives to achieve. The definition of standards, visual management and the introduction of Kaizen meetings with all workers should be implemented in order to achieve the objective and reduce the deviations or problems occurred in this area. Audits are also important to sustain the improvements.

The evaluation tool used in this study could be used for this purpose. According to [9] an audit enables an organization to recognize the juncture that it has accomplished and develops a regular rhythm, engaging managers in predictable ways with assigned responsibilities.

After the implementation of the machine is expected a decrease in the stress of the workers and a significant improvement of their health and well-being.

IV. CONCLUSIONS

Despite the implications in terms of absenteeism due to occupational diseases caused by work, managers still do not see the ergonomics and workers' well-being as an investment but rather as a cost.

Automation could be a key solution to improve worker well-being, by reducing or eliminating the awkward postures and effort to perform manual tasks. It is estimated that stress levels could also be reduced. However, stress measurement was not the aim of this study and it may be one of the factors to be measured in the future.

The audit tool proved to be a great way to assess the initial situation and should be used frequently to improve the process and workers' well-being.

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