POSMEC 2016 – Postgraduate Symposium in Mechanical Engineering
Department of Mechanical Engineering – Federal University of Uberlandia
December, 1st to 2nd, Uberlandia, Minas Gerais, Brazil

UNIVERSAL HANDLE FOR TRANSPORTING BOXES

Marcus Vinicius Rezende Júnior, Federal University of Uberlândia, School of Mechanical Engineering, marcus_aluno7@yahoo.com.br
Pierre Grailhe, National Engineering Institute in Mechanics and Microtechnologies, pierre.grailhe@ens2m.fr
Romain Jamault, National Engineering Institute in Mechanics and Microtechnologies, romain.jamault@ens2m.fr
Pierre-Henri Cornuault, National Engineering Institute in Mechanics and Microtechnologies, pierre-henri.cornuault@ens2m.fr

Abstract: *The practice of designing systems, products and processes to take genuine account of the interaction between them and the people who use them is more and more frequent. A lot of different disciplines like engineering, anthropometry, physiology and psychology have provided contributions to develop proper ergonomic design, in order to prevent injuries and musculoskeletal infirmities. This paper aims to discuss about a handle in detailed design for handling and transporting cartons and to be used for all types of people. Some basic characteristics like ergonomics, lightness, robustness, adaptability, ease of use, easy storage and low cost constitute fundamental criteria in choosing the ideal system.*

Keywords*: ergonomics, universal handle, biomechanics*

1. INTRODUCTION

Ergonomics (also called “humans factors” in some industries such as major hazards, transport and defence) can be explained simply as the study of work. More specifically, ergonomics is the science of designing the job to fit the worker, rather than physically forcing the worker’s body to fit the job. Adjusting tasks, work stations, tools, and equipment to fit the worker can help decrease physical stress on a worker’s body and remove many potentially serious, disabling work related musculoskeletal disorders (MSDs). Ergonomics draws on a number of scientific disciplines, including physiology, biomechanics, psychology, anthropometry, industrial hygiene, and kinesiology.

According to the International Ergonomics Association, within the discipline of ergonomics there exist three domains of specialization: physical ergonomics, cognitive ergonomics and organizational ergonomics. Physical ergonomics is related to human anatomy and some of the anthropometric, physiological and biomechanical characteristics as they relate to physical activity. Physical ergonomic principles have been broadly used in the design of both consumer and industrial products. Cognitive ergonomics is concerned with mental processes, such as memory, perception, reasoning and motor response, as they have an effect on interactions among humans and other elements of a system. Organizational ergonomics is associated with the optimization of socio-technical systems, including their organizational structures, policies, and processes.

Industries increasingly are in need of higher production rates and advances in technology to remain competitive and keep in business. As a result, jobs currently can involve increasing specialization that requires the worker to accomplish only a function or movement for a long period of time. Working day after day at a quicker pace of work, like faster assembly line speeds or having tighter grips when using tools, frequent lifting, carrying, and pushing or pulling loads without help from other workers or devices is also a problem related to ergonomics. These factors, especially if associated with poor machine design, tool, and workplace design or the use of improper tools can generate physical stress on workers’ bodies, which can lead to injury.

Musculoskeletal disorders are injuries and disorders of the nervous system and soft tissues (muscles, ligaments, joints, tendons and cartilage). They can affect nearly all tissues, including the nerves and tendon sheaths, and most frequently entail the arms and back. A dramatic increase in MSDs began in the 1970s when these disorders increasingly appeared on companies’ injury and illness logs. Occupational Safety and Health Administration (OSHA) cited companies for perilous workplace conditions that resulted in problems such as tendinitis, carpal tunnel syndrome and back injuries. MSDs can cause pain, numbness, tingling, stiff joints, difficulty moving, muscle loss and sometimes paralysis. Frequently, workers must lose time from work to recover; some never regain full health.

2. THE APTE METHOD

Before performing any diagnosis or searching for any solution, it is required to define clearly the purpose and objectives. This must be done without any preconceived solution, by questioning the existing solution in order to open all possible solutions. The studied object is replaced in its use environment (for example associated product, process, etc.) in order to search the functions or services to be provided to the users.

For each service to be provided, the APTE method characterizes the expected quality level (user's satisfaction criteria). On the basis of the functional specifications, it allows identify the quality or means gaps of the current solutions. At the final phase of products design, the solutions will reach the expected quality level at the lowest cost/resources

After some researches on ergonomics and maintenance, a suitable technical solution could be proposed. The proposed tool have to allow anyone to easily handle any type of carton. To define the need to which the system answers, it is interesting to use the "horned beast" tool Fig. (1).

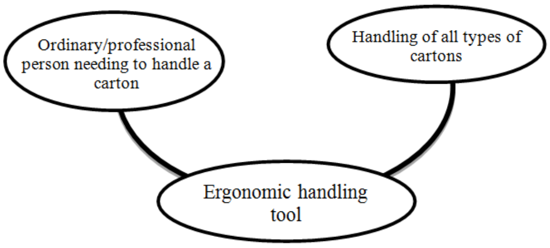

Figure 1: Project specification (REZENDE JÚNIOR)

3. UNIVERSAL HANDLE SPECIFICATION

Continuing to apply the APTE method, the next phase is to identify and formulate functions related to the tool. The Octopuss is used to provide these information, Fig. (2). The main function links user and carton and as a complementary function there are the support of the tool and the environment:

- Main function: facilitate the handling of all types of cartons by the user
- First complementary function: allow easy storage
- Second complementary function: resisting and adapting to the environment

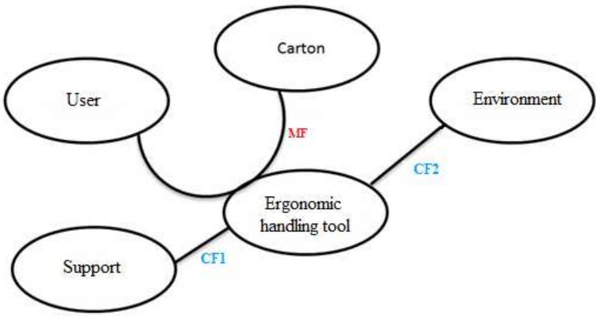

Figure 2: Identifying and formulating functions related to the system (REZENDE JÚNIOR)

4. FUNCTIONNAL ANALYSIS

One of the initial specifications the tool must perform was that it should be universal. The objective of the project was then to design a system that could be used by all types of people (young and old adults, professionals or ordinary users) and to allow the handling of all types of cartons. This general criterion made it difficult to approach the problem and to identify the needs tool. This phase is about establishing precise criteria and defining the prerequisites that the user has to fulfill. The dimensions of the cartons that the system could handle are also limited. Some of other characteristics related to the tool are:

- Mass and shape of the carton;
- Age, sex, physical strength, educational level;
- Form of the tool;
- Environmental conditions to use the tool (temperature, pressure, humidity, cleanliness);
- Oxidation resistance, flammability, toxicity and recyclability.

5. SEARCHING FOR TECHNICAL SOLUTIONS

Many technical solutions were proposed before choosing the final one, inspired in a one-hand clamp, Fig. (3).

Figure 3: One-hand clamp (Wolfcraft)

This mechanism has the advantage of being at the same time not bulky, fast use, usable with one hand and allowing a simple transport of cartons of variable dimensions.

6. TOOL DESIGN

Using the CAD software CREO, the tool design could be done, Fig. (4). A kinematic analysis could be made with the same software, not present in this paper.

Figure 4: Tool design (REZENDE JÚNIOR)

7. HANDLE MATERIAL AND SHAPE

The additional criteria used to design the tool are not available on this paper. The more criteria are required the more complex is the selection. To choose the handle material, the main goal of material selection is to minimize cost while meeting product performance goals. The selection of the best material for the tool begins with properties and costs of candidate materials. Using an Ashby chart the material is selected with the CES Edu Pack software. The material was chosen according to all the design criteria. The shape of the handle is given in Fig. (5). It is hollow to allow the integration of the developed mechanism.

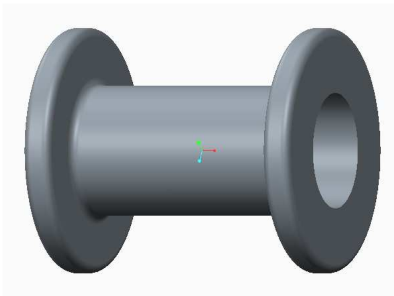

Figure 5: Handle shape (REZENDE JÚNIOR)

8. REFERENCES

Ergonomics and human factors at work: A brief guide. Health and Safety Executive, 2013. < http://www.hse.gov.uk/>.

Ergonomics: The Study of Work. U.S. Department of Labor Occupational Safety and Health Administration. OSHA 3125, 2000 (revised).

DIETER, G. E. Overview of the Materials Selection Process. ASM Handbook Volume 20: Materials Selection and Design, 1997.

International Journal of Human Factors and Ergonomics.
International Journal of Industrial Ergonomics.
International Journal of Occupational Safety and Ergonomics.
REZENDE JÚNIOR, M. V., BEHEM, G., GRAILHE, P., JAMAULT, R., CORNUAULT, P. H. Projet interdisciplinaire : conception d'une poignée universelle. ENSMM, 2014.
U.S. Department of Labor, Bureau of Labor Statistics, News Release, "Lost-worktime Injuries and Illnesses; Characteristics and Resulting Time Away from Work, 1998.
Wolfcraft, manufacturer tools. < http://www.wolfcraft.com/en/home/index.html>.

9. RESPONSIBILITY NOTICE

The authors are the only responsible for the printed material included in this paper.