

# Ergonomic Considerations to be Taken into Account in Designing Functional Knobs for Industrial Products

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## **Abstract:**

Ergonomics is the process of designing different products that users deal with in a way to ensure comfort and safety for them, therefore ergonomics is known as the art of design to offer better luxury and comfort for people. For various industrial products, despite their technical development however the interactive side between them and the user still exists, specifically for functional knobs which represent their importance for user in addition to their direct physical effect on him/her. For example , studies indicate the use of hand tools is in response to which approximately 9% of the overall occupational injuries which shows the effect of designing functional knobs on user (Aghazadeh,1986).This research addresses an analytical study of the various functional knobs in industrial products in which it depends on a direct interaction between them and the user and requires him/her to use hands and arms with a certain force to be able to use and control them in which it will lead to have a set of ergonomic considerations as a reference for designers and industrial design students in order to help them in designing their functional knobs with different products and improving their usability and ergonomical function of them in a way to ensure comfort and safety for all users of all categories and ages.

## **Keywords:**

User, Industrial designer, Ergonomics, Occupational Injuries, Industrial Design, Hand Tools

## **1. Introduction**

Ergonomics has emerged as a science capable of providing design solutions to the problems arising from the user's interaction with various industrial products, with the study of operating conditions that can directly or indirectly affect the user. Studying and evaluating the external design of the product, and ensuring its ability to help users perform their jobs easier and faster, while reducing the error rate that arises from the operations and interaction between the user and the product to the lowest possible level.

Looking at the nature of the various industrial products, it is noted that the design of functional handles in these products occupies the first place in terms of the relationship and interaction between the user and the product, as these grips are the first means to help the user use and control the product, so any shortcoming in the design of these handles in their different forms can be It directly affects the user, making him feel uncomfortable and unable to use the product in a comfortable and safe way, as well as indirectly affecting him in the long run, through the appearance of physical and muscular problems for him, so the correct design of the functional grip leads to better performance for the user .

## 2. Research Topic

Many industrial products and services depend on the muscular side of the user, through the use of his arms and hands to be able to use it optimally, as well as tight control of the product and the ability to move it, so the design of a good functional handle is important for both the designer and the user alike. To reach the best designs for those handles to ensure ease of use, in addition to achieving safety standards between the user and the product, while the user is looking for a comfortable handle design so that he can perform the function without an obstacle between him and the product.

Therefore, the design of functional handles is of paramount importance in the field of product design, and researchers usually seek through the science of ergonomics to reach a set of requirements and criteria to be taken into account when designing those handles, so that designers can reach the optimal design. Recognizing and studying these standards, to help them in the future to provide design solutions for functional handles that suit the nature of the user. Therefore, the research deals with the information and standards that must be taken into account by designers and industrial design students, in order to reach a good handle design that suits the user and achieves safety standards when using.

## 3. Research Problem

The research problem is the absence of a clear and tidy list of ergonomic considerations to be taken into account by designers and industrial design students when designing functional handles with industrial products, which is negatively reflected on the performance of the product and the nature of the interactive relationship between the user and the product.

### 4. Research objective

The research aims to develop a list of ergonomics considerations to be taken into account by designers and students of industrial design when designing different functional handles in products.

## 5. Importance Of Research

The importance of the research is as follows:

- Clarify the importance of ergonomics and the role it plays in product development and improvement.
- Clarify the role of functional handles that they play in the interactive relationship between the user and the product.
- Develop a list of considerations to be taken into account when designing functional handles by designers and students of industrial design.
- The ability to reach designs for functional handles in industrial products that achieve safety and comfort for users.

## 6. Research Methodology

The research follows the descriptive analytical approach to arrive at a methodology that helps the student to set the requirements to be taken into account when designing functional handles.

## 7. Force Search

Establishing a list of ergonomic considerations for the design of functional handles in industrial products as a reference for both designers and students of industrial design, will lead to arriving at a design suitable and suitable for the user.

## 8. Conclusion

The science of ergonomics is concerned with improving the performance experience between the user and the product, and achieving maximum standards of comfort and safety during use, so this science has been called "the art of designing for the comfort and well-being of users". In view of the nature of the various industrial products, it is noted that the use handle in many of them is the direct means of interaction between the user and the product, so the presence of any defect in the nature of the design of the functional handle and the failure to achieve standards of safety and comfort in use, is directly reflected in the result of the interaction process and the functional and usability aspect The product, whether through poor experience of use or through indirect effects, represented in causing physical and muscular problems for the user in the long run. Therefore, institutions and academies have been interested in searching for specific criteria that the designer can benefit from when designing these functional handles, and to avoid the consequences of that process in the future. Through this research, the researcher followed the descriptive analytical approach, by analyzing a set of studies and research to determine a set of requirements that must be met when designing functional handles. Studies that fulfill the criteria previously identified by the researcher and considered as a basic reference for him, enabling him to determine the main requirements that must be met for the design of functional handles. After studying and analyzing previous studies, the researcher reached an initial reference list that is considered a nucleus that can be relied upon and benefited from in the design of functional handles. At the Faculty of Applied Arts - Beni Suef University, where part of the course description deals with training students to design handles of a variety of different hand tools and tools, and training them on how to apply this methodology by visualizing the proposed design process from the perspective of ergonomics, and applying the standards that have been set. The design process consists of three stages: the first stage is the collection and analysis of information, and it was carried out through specific criteria represented in (determining the type of fist used - reviewing the engineering aspects and measurements of the product - reviewing the safety aspects - determining the advantages and defects of the product according to the main design considerations - developing a proposal for development) . Then comes the second stage, which is the stage of developing ideas and benefiting from the proposals identified in the previous stage of development, in addition to applying the ergonomic criteria and requirements previously identified by the researcher in the proposed ideas. Then the third stage comes the stage of reviewing the design and ascertaining the extent to which it fulfills the ergonomic criteria for the design of functional handles, and its impact on the user experience, by converting the proposed design into a physical image and presenting it to a group of users for use and evaluation through the specified form, in addition to photographing and analyzing the different positions of the grip. User and analyzed according to the criteria previously defined. From the previous experience, the researcher was able, with the help of students, to reach designs that take into account the ergonomics and usage aspects, and fulfill the requirements to be taken into

account when designing functional handles with different products as a preliminary experiment, to verify the effectiveness of the proposed standards, and to expand the experiment in a more comprehensive and larger way to include more difficult and complex products, and to become a nucleus It helps researchers to complete studies and research related to this field. Thus, the researcher has achieved the main objective of the research, which is to develop a list of ergonomic considerations to be taken into account by designers and students of industrial design when designing different functional handles in products.

## 9. Results

- Ergonomics aims to achieve comfort and safety when using products.
- The design of functional handles in these products ranks first in terms of the relationship and interaction between the user and the product, as these grips are the first means to help the user use and control the product.
- The inappropriateness of the design of the handles in different forms directly affects the user, making him feel uncomfortable and the inability to use the product in a comfortable and safe way, as well as indirectly affecting him in the long run through the emergence of physical and muscular problems.
- The more user-friendly the handle design, the less errors and impacts related to the use process.
- The correct design of the handle is very important for the prevention of various muscular disorders, which occur in the upper limbs of the user due to the nature of use.

The type of grip used to hold functional handles can be divided into two main types: Power grip and precision grip.

- The appropriate diameter of the tool handle is estimated at 19.7% of the total length of the tool.
- The oval shape of the handle is best in use, so that the ratio of length to width is 1.25:1.
- Studies indicate that the length of the handle suitable for the user ranges between (100-125 mm), the average width of the hand for males is approximately 87 mm and for females is approximately 78 mm.
- The weight of the tool that requires strength in use should not exceed as much as possible 1.4 kg, the higher the weight, the greater the effort exerted by the user.
- The weight of the tool that requires accuracy in use should not exceed 0.5 kg, the higher the weight, the lower the accuracy due to the pressure force acting on the user's hand.
- Users prefer to use tools and tools with a 10 degree inclined handle over straight grips, and studies indicate that using a tilt angle to design the handle between an angle (20-40 degrees) can reduce the negative effects resulting from the use of the user's wrist.

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