

# INTEGRATION OF GENDER IN THE DESIGN PROCESS OF MECHATRONIC PRODUCTS: AN INTERDISCIPLINARY APPROACH

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## 1. Introduction

During the design process a lot of information and requirements have to be considered and evaluated. In order to develop the best product or machine for the market a complex engineering process has to be performed. Numerous design criteria and requirements ranging from purchase, manufacturing up to sales should be considered and fulfilled but they can be in conflict. This evaluation is a laborious process and the trade off should result in an efficient performance of the machine depending on its functionality and the acceptance of the operator. So it is important to consider gender and operator requirements in the design process, which is not usually done in the industrial application of mechatronic products.

A systematic research process has been performed and established in order to evaluate the impact of user requirements onto the functionality and design of industrial devices with the main focus on the gender dimension and its social aspects in all steps of the design process. The results of this research lead to developing guidelines for finding and including the most important requirements in the design process. The proper evaluation of these requirements determines the success of the product, e.g. including them in a specific human-machine-interface. Innovation and new ideas have to be evaluated with respect to the requirements profile derived by these guidelines.

## 2. Product Development Process

Different strategies and methods are applied when designing a new or an improved product. Many components of machines have to be

designed to fulfill specific functions and their operation and availability is critical for the performance of the machines. Particularly finite element method analysis of the deformation of the components of the machines and numerical simulation and experimental measurements of the vibrations of machine components and the acoustic emission depending on the operation conditions should be performed. Simulation of the air flow during the production process of defined materials is performed to predict the quality of products. The knowledge of the machine operator requirements is important in finding the best machine parameters.

### 2.1 *Conventional mechanical engineering approach*

During the development and design process all relevant requirements are evaluated with respect to their impact to functionality. In this I-methodology procedure the design engineer considers all the known parameters and influence factors, like function, productivity, reduced faults, availability, emission, ergonomics, etc., see [1], according to the own experience and preferences. Involuntary important requirements can be unconsidered which can be challenged by taking gender and operational experiences systematically into account.

### 2.2 *Multicriterial approach*

In the process of integrated product development various additional factors are considered so that the product is suitable designed for processing, mounting, maintenance, ergonomic, wear, corrosion, risks, etc, see [2]. In evaluating and weighting various influence factors a pareto-optimal product can be derived based on a checklist and possible general requirement profiles and a flow chart of the design process are used. In

the participative design process more persons are involved and bring in their knowledge as experts.

### 2.3 Integrated gender approach

More factors are considered when the gender dimension is included, see Fig. 1. Frequently in the design process the focus is on objective and rational factors but there is an extension if the machine operators are included as experts into the design process of the new machine generation. A procedure was developed in this research project, which allows the integration of gender aspects in requirements at every level and in all fields of the design process. The results are modifications of e.g. the acoustic emission, the size of the operator panel, the outer shape of the machine and the positioning of the human-machine interface.

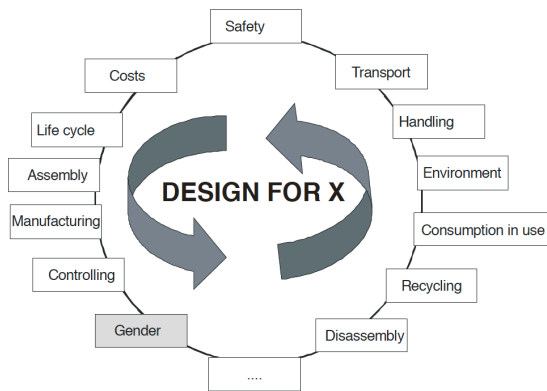


Fig. 1. Scheme of Design for X.

### 3. Methods of Analysis

For the analysis of gender-relevant requirements qualitative and quantitative methods have been applied. The procedure was developed in a general setting and is demonstrated for the application to laser engraving and cutting machines, see [3]. As *quantitative methods* in a first step structured interviews with experts and operators were conducted to explore their different requirements. Based on this information in a second step a written questionnaire has been developed and sent to the machine operators from different companies. In a third step the workflow-analysis was monitored on a group of operators to get additional information. As *qualitative methods* an exchange of opinions about daily experience by the work with the machines was organized within a framework of designed focus groups with operators. To gain further insight the existing and necessary functions have been discussed. The results of these two methods were included in a

extensive participatory design process. The result of these settings is a list of gender relevant requirements, which has to be matched with all other requirements in the design process of a new product or machine as shown in Fig. 2.

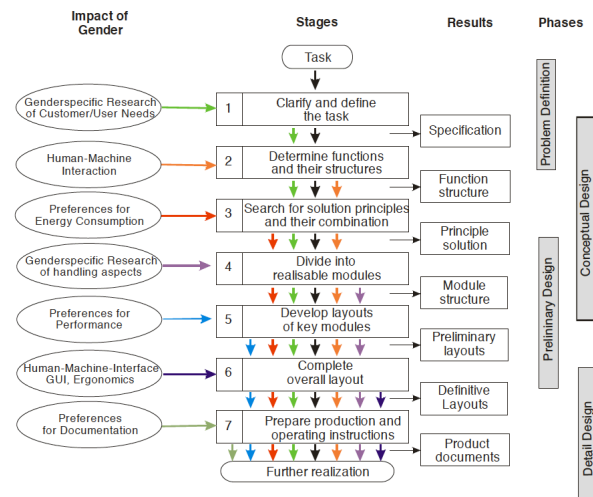


Fig. 2. Influence of Gender in the Design Process.

### 4. Results

A new design procedure for industrial machines was developed taking the complexity of users experience and gender into account. Product requirements lists including the user requirements have been derived in a stepwise procedure. The application to the new design of a laser engraving and cutting machine resulted in an improved machine with many new features.

### Acknowledgements

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