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METHODS FOR DETERMINING THE AESTHETIC APPEAL OF FURNITURE

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Abstract:
The world of furniture market is getting more and more complex than it was before. In recent years the habits of buying furniture have changed. The fabrication of individual pieces of furniture is increasingly coming to the front. A personal contact is being established between the customer and the furniture, which is a relationship of one product to one customer. In order to satisfy the individual demands, higher prices and higher quality are needed. The competition is beginning at the market and emotion plays an important role in it. Therefore, functionality and aesthetic functions, determinative forms, fashionable style play a very important role in furniture design and production. Some methods are presented such as RMQD or FMEA used for determining aesthetics of furniture.

Key words: *aesthetics; functions; furniture; methods; proportion.*

INTRODUCTION

Function can be expressed as the properties related to the use of a product. These properties include the relation between product and consumer (Antal 2007).

On the basis of purchasing motivation the system of functions can be divided into:

- functionality and
- aesthetic functions.

The aesthetic functions have a special role in view of furniture. Aesthetic value is considered to be the effect (or style) of objects as to what degree they can teach us to perceive or understand the appeal of beauty. Nevertheless a designed object, such as a piece of furniture, can be evaluated regarding whether beauty is involved in it, or not. In the competition that occurs in the market when choosing furniture preference is given individuality and emotions (Domljan and Grbac 2014).

In industrial design, objects are created with the intention to satisfy not only aesthetic criteria but also, primarily, criteria of utility and practical function (Papanek 2005).

These functions are inseparable, on the products such as furniture they can only appear jointly. “There is no separate usefulness and beauty, but what is useful is considered beautiful as well.” (Lissák 1997). Generally we buy a piece of furniture to use it and to take pleasure in it. The question is what the proportion of functionality and aesthetic functions in the case of furniture is? This proportion has to be determined to satisfy consumer demands. To establish this proportion, both functionality and aesthetic functions have to be measured. A numerical expression of these functions was defined. It is important to notice that particular exact method which precisely determine the proportion of these functions still does not exist. A number of experiments have been carried out, but the exact definition of aesthetic functions has been based on modelling consumers’ value judgements (Antal 2007). The quality of two similar products can be measured on the level of function satisfaction. The satisfaction measure determines which product is better, more beautiful and more attractive (Lissák 1997).

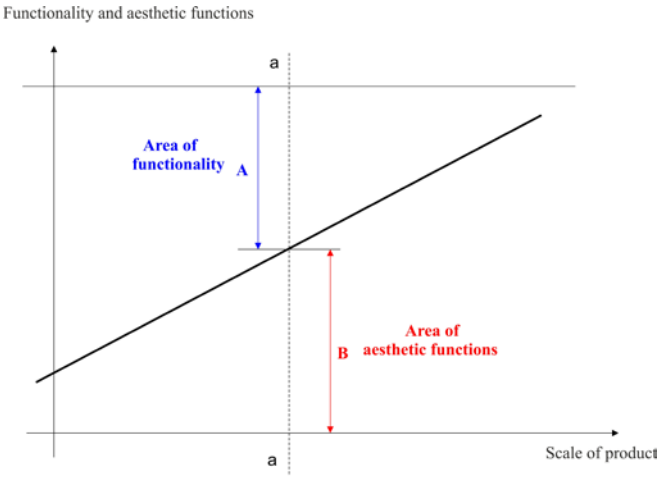

Fig. 1.
Representation of proportion of functionality and aesthetic functions (Hegedűs 1983)
a-a – position of furniture on the scale; A/B –proportion of functionality and aesthetic value.

Optimal aesthetic quality of a product depends on the proportion of *A/B*, represented in the section *a-a*. This proportion is to be designed according to customer demand, i.e. in an optimal way.

OBJECTIVE

The objective of this paper is to report on a research, including the analysis of the proportion of functionality and aesthetic appeal of furniture. The functions express the relationship between the product (furniture) and its user. This paper presents some research results how function and aesthetics appearing of the different styles of the furniture could be determined, measured and could influence to customer requirements and demands by using RMQD and FMEA methods.

METHODS

From designers' point of view, it is very important what kind of methods are used to determine optimal proportion of the requiremenst of the product and for what purposes the proportion could be used as well. Some of designers' methods are:

- Optimization
- Function analysis
- Questionnaire research
- Ranking Method Quality Development
- Failure Mode and Effects Analysis

Optimization of proportion of functionality and aesthetic functions

A product consists of subsets of functionality and aesthetic functions which mostly means the aesthetic quality of the product. The proportion of functionality and aesthetic functions is optimal if it meets the demands of consumers.

According to Hegedűs, aesthetic functions are analysed separately from functionality. He gave values for functionality and aesthetic functions (Hegedűs 1994).

If functionality of a product is to be:

$H_1, H_2, \ldots H_i \ldots H_n$;
the aesthetic functions of a product is to be:
$E_1, E_2, \ldots E_j \ldots E_m$;
follows that:
h_i is the value of H_i ; e_j is the value of E_j
and if these functions are linked to the product, which is supposed to satisfy the customers' needs, it can be express as follows:

$$\varepsilon_j = \begin{cases} 1, \text{ if } E_j \text{ is carried by the product} \\ 0, \text{ if } E_j \text{ is not carried by the product} \end{cases}$$

$$\delta_i = \begin{cases} 1, \text{ ha } H_i \text{ is carried by the product} \\ 0, \text{ ha } H_i \text{ is not carried by the product} \end{cases}$$

Using these values, the proportion of functionality and aesthetic functions can be expressed by the formula:

$$\frac{\sum_{i=1}^{n} \delta_i h_i}{\sum_{j=1}^{m} \varepsilon_j e_j} = opt. \qquad (1)$$

As an example in Table 1 there are some functions (F_i) of a product which could be observd and analysed.

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Table 1

Some of the functions of a product to be analysed

Aesthetic functions (F_i)	Functionality (F_i)
$E_1 = F_2$ Satisfy of ergonomics needs	$H_1 = F_2$ Satisfy of ergonomics needs
$E_2 = F_1$ Accommodate to the house	$H_2 = F_4$ Help the work
$E_3 = F_3$ Satisfy aesthetic needs	$H_3 = F_5$ Measure up to the medical regulations
$E_4 = F_6$ Orientate to the ambience	$H_4 = F_6$ Orientate to the ambience
$E_5 = F_8$ Carry face	$H_5 = F_8$ Carry face
$E_6 = F_7$ Carry style	

Using the formula (1) and the data in the Table 1, it can be written as follow:

$$\frac{\delta_2 h_2 + \delta_4 h_4 + \delta_5 h_5 + \delta_6 h_6 + \delta_8 h_8}{\varepsilon_1 e_1 + \varepsilon_2 e_2 + \varepsilon_3 e_3 + \varepsilon_6 e_6 + \varepsilon_7 e_7 + \varepsilon_8 e_8} = \frac{a}{b} = opt. \quad (2)$$

The optimization means a constriction within interval on the basis of a criterion. With numerous sampling, a/b rates can be defined and evaluated, as well as the customer satisfaction (rate of satisfaction). The probability value of weighted rate shows the optimum scale (proportion). The type and specifics of distribution can be determined, and by means of these the bottom and upper limits of confidence intervals of e.g. 95% (Fig. 2).

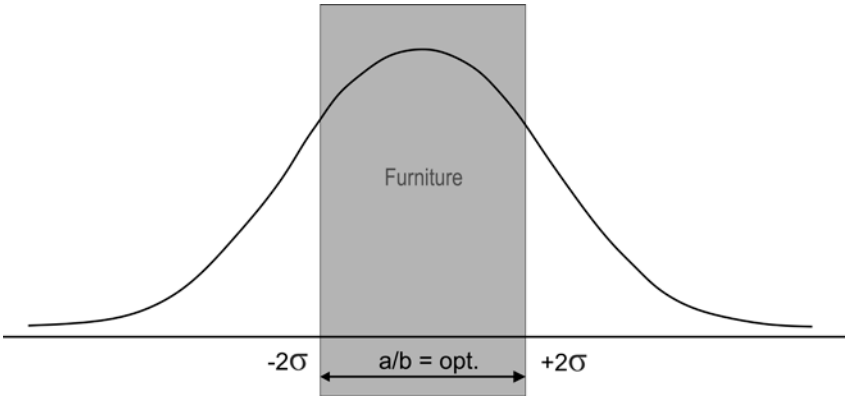

Fig. 2.
The optimisation of criteria in furniture (Antal 2007).

If the value, for example, is -2σ<a/b<+2σ, it can be declared, that the furniture is aesthetically acceptable or the furniture is exclusive.

Aesthetic numbers for the practical expression of the relation can be suggested, the applicability of the theoretical relation for furniture can be reviewed.

Function analysis

Identifying *customer needs* means creating a high-quality information channel from the customers to the product developers. This will ensure that those who directly control the details of the product, including the product designers, understand the needs of the customer. Those needs has to be organized into hierarchical list in order to be more understandable. The methods which can be used for identifying customer needs are interviews, focus groups, observing the product in use.

The customer needs are helpful to define the *functions* of a product. The needs have to be transformed into functions. Functions are abstractions of what a product should do. A limited number of elementary or general functions on a high level of abstraction create a function structure. The functions are organised into a hierarchical order, in a so called tree structure.

Function analysis is a method for analysing and developing a function structure. A function structure is an abstract model of the new product, without material features such as shape, dimensions and materials of the parts. It describes the functions of the product and its parts and indicates the mutual relations. In function analysis, the product is considered as a technical-physical system. The product functions consists of a number of parts and components which fulfil sub-functions

and the overall function. By choosing the appropriate form and materials, a designer can influence the sub-functions and the overall function. The principle of function analysis is to specify what the product should do and then to infer what the parts - which are yet to be developed - should do as well. (Boeijen *et al.* 2013).

By selecting aesthetic functions from the tree structure and by using them in Failure Mode and Effects Analysis, the aesthetical quality of the product in the planning stage can be assured. The measure of the aesthetic functions has become possible by functions value and the weight numbers of determinative style.

Failure Mode and Effects Analysis (FMEA)

Failure Mode and Effects Analysis (FMEA) is a model used to prioritize potential defects based on their severity, expected frequency, and likelihood of detection. An FMEA can be performed on a design or a process, and is used to prompt actions to improve design or process robustness. The FMEA highlights weaknesses in the current design or process in terms of the customer, and is an excellent vehicle to prioritize and organize continuous improvement efforts on areas which offer the greatest return. The process is very straightforward, and begins by identifying all of the probable failure modes. This analysis is based on experience, review, and brainstorming, and should use actual data if possible (*** 2014).

The failure mode and effects analysis model can help teams decrease project scope and complexity by focusing in on the primary failure modes of a process. Creating an FMEA is best done by coordinating a cross-functional team and using objective and subjective knowledge to identify accurate properties about the identified failure modes.

This method can be used by taking into consideration only aesthetical functions combined with function analysis. It means that the aesthetical functions of furniture could be determined and the aesthetical characteristics and forms of furniture could be analysed. A function structure of the furniture can be created in order to select the aesthetical functions, and to introduce in the FMEA process to make possible measuring them. The functions with failured result are assigned by the elements of the furniture. For these functions the potential failures are identified as well as the effects and reasons of the failures. The control for prevention is established for all potential failures. The effect and the level of satisfaction of the customer is analysed by the team if one of the aesthetical function is not satisfied. In this occasion, the disappointment of the customer is measured. For the aesthetical functions the relevance measurer numbers are determined. The severity of the failure with these numbers can be appreciate. Example: if an aesthetical function is not satisfied, this is marked as a failure. The importance of the failure's effect (severity) can be expressed by a weight number. Scoring is made from the customer's perspective, on a scale from 1 to 100 (10 if the customer perceives the aesthetical value 100%, 1 if the customer hardly perceives the value) (Table 2).

Table 2

Severity (Importance of the failure)

Detection of the value of the aesthetical function (%)	The degree of the failure's effect	Weight number
(The customer completely perceives the value of aesthetical function) 90-100	Very high	10
80-90	Very high	9
70-80	High	8
60-70	High	7
50-60	Medium	6
40-50	Medium	5
30-40	Medium	4
20-30	Low	3
10-20	Low	2
0-10 (The customer hardly perceives the function value)	Very low	1

The next step is to assign a value on a 1-10 scale for the probability of occurrence, as well as for the probability of detection for each of the potential failure modes. After assigning a value, the three numbers for each failure mode are multiplied together to yield a Risk Priority Number (RPN). The RPN

becomes a priority value to rank the failure modes, with the highest number demanding the most urgent improvement activity.

During the analysis determining the aesthetical functions of furniture and taking into consideration their realization rate will open possibility to measure aesthetical functions and to improve the aesthetical quality of furniture. The quality is optimised by eliminating all possible failures, locating their impacts and reasons before getting to the customers.

Ranking Method Quality Development (RMQD)

The RMQD is a method which is used for matching and comparison of furniture and concurrency analysis. Compliance with the functions of the determining forms is defined with this method and ranked by means of the degree of correspondence.

A threshold value can be defined as:

- The pieces of furniture that are situated above this threshold value meet the requirements (e.g. they are exclusive),
- The pieces of furniture that are situated below this threshold value do not meet the requirements (e.g. they are not exclusive).

Through the determining forms, the aim is to detect the proportion of aesthetic and functional properties by certain properties. The assessment factors can then be measured by using some properties which are not of equal weight, but are ranked by RMQD. This can help create a basis for comparison, which enables us to establish whether these properties are included in the furniture and to what degree they are present.

An assessment method based on the overall emotions was created. The method aimed at determining the range of style properties for a given furniture family. The algorithm presented below is suitable for applying this assessment method (Fig. 3).

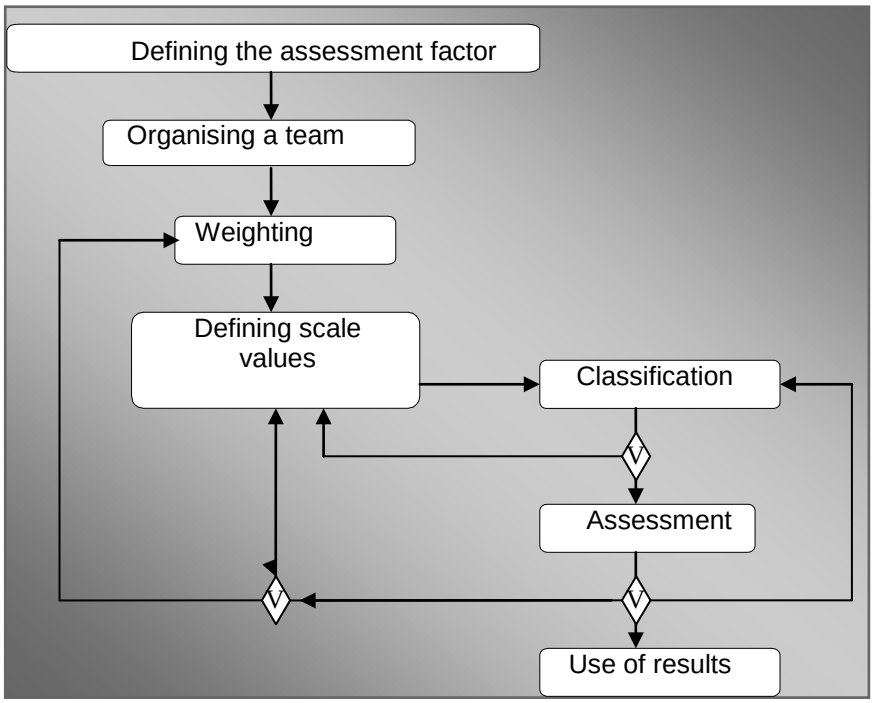

Fig. 3.
The algorithm for applying the assessment method (Antal 2007).

Questionnaire

The answer to the problem of what kind of furniture properties allow determining the style of a group of furniture could be established with a questionnaire. On the basis of the answers, an order of rank may be formed and the first ten properties will then be considered. The answers should provide some information on the fact to what degree (what percentage) the given pieces of furniture meet the criteria of a given style, and what kind of weighted order should be arranged. The RMQD surveying system is suitable for this kind of complex measurement.

RESULTS & DISCUSSION

For the research five groups of furniture were selected as the samples from different points of view. The rank of selection was high quality furniture made from massive wood. Quality in this occasion means high aesthetic, construction, technology and economics level of requirements. Groups of furniture samples used for the RMQD analysis were ranked from A to E.

First phase of the research was organizing a team and determining the parameters. The agreement coefficient of the team was over 90%. The distribution of the team members' evaluation was ± 10%.

The process of the research was determined in the order of steps as follow:

- determining the task, meeting of the team members
- studying the collected documentation of the selected furniture
- the previous steps of research were studied and accepted as the input results; e.g. 7 items out of the 10 style properties was considered as characteristic of the style
- the properties and requirements were classified and weighed - compared
- the selected 5 groups of furniture were analysed and composed in group work, the values of 5-1 scale (5 equals the assessment factor which the furniture best complies with) was renked
- the assessment factors were evaluated individually by each member of the team, which was carried out by means of a assessment list (Table 4)
- all the data were analysed by statistic computer programms, presented in tables and diagrams as well
- the partial results were analysed and performed as the required common assessment.

After anallytical data processing, the research results appears as follows:

The agreement coefficient is over the required 90%. The team member whose assessment range was over the standard threshold value was excluded by the computer when arranging the results.

The order of the previously established assessment factors was in compliance with the order of rank of the pilot survey.

The weighted order of the assessment factors was as presented in the Table 3 and Fig. 4.

Table 3

Weighted order of the assessment factors

Assessment factors	**Weighted order of rank**
aesthetic appeal	24,00
material-colour harmony	21,05
visible style properties	19,84
harmonious appearance	9,97
typical rate of proportions	8,65
smartness	8,33
pureness of style	8,16

The list of one of the assessing team members is shown as an example in the Table 4.

Table 4

Assessment list

Assessment factors	**Furniture**				
	A	**B**	**C**	**D**	**E**
aesthetic appeal	4	4	4	5	4
material-colour harmony	3	4	4	5	4
visible style properties	2	4	3	4	4
harmonious appearance	4	4	4	5	4
typical rates of proportions	3	4	4	4	4
smartness	3	4	3	4	4
pureness of style	3	5	4	5	4

The final result of the survey shown that the five groups of furniture are in compliance with the criteria of style (Table 5).

Table 5

Order sample of the most excusive to the least exclusive furniture according to results

Score/number	Sample/product	Result/percents
1	D	94,3%
2	C	90,6%
3	E	89%
4	B	82,5%
5	A	72,7%

Based on the results, a threshold value, e.g. 70%, can be determined. Over this value the furniture may be considered as exclusive.

CONCLUSIONS

The demands of costumers are maximally satisfied when the proportion of functionality and aesthetic functions converge to the expectations of customers.

The numerical expression of the subjective value judgment for designing furniture can be used for concurrency analysis and for quality examinations.

An evaluating algorithm can be developed by using the RMQD. This method can be used very effectively for designing and marketing furniture and for modelling customer satisfaction as well.

FMEA could also be used in connection with aesthetic functions, assuring the quality of the product in the planning stage.

The FMEA's algorithm can be applied in the design process. The aesthetic functions of a product are to be taken into consideration in the analysis by properly establishing the criteria with regard to the product being analysed.

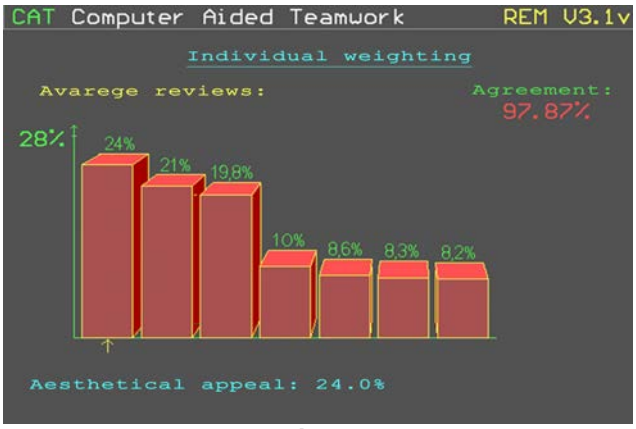

Fig. 4.
Weighted order of the assessment factors (Antal 2007).

REFERENCES

Antal MR (2007) Analysis of determinative forms of furniture of excellent quality from the point of view of developing the optimal proportion of function and aesthetics. PhD Diss, University of West Hungary, Faculty of Wood Industry, Sopron.

Boeijen A, Daalhuizen J, Zijlstra, P, Schoor R (2013) Delft Design Guide: Course Home (Function Analysis). Online at: http://ocw.tudelft.nl/courses/product-design/delft-design-guide/course-home/

Domljan D, Grbac I (2014) IMM Cologne 2014, Sajam noviteta i dizajna, prirodnoga i funkcionalnoga (The Fair of novelties and design, natural and functional). Wood industry 65(1):75-82.

Hegedűs J (1983) Értékelemzés és rendszerelmélet az ipari formatervezésben (Value analysis and system theory in industrial design). Tankönyvkiadó IGK, Budapest.

Hegedűs J (1994) A műszaki fejlesztés folyamatainak összehangolása és korszerűsítése értékelemzéssel (Harmonization and modernization of the processes of technical development by using value analysis). Doktori értekezés, Budapest.

Lissák Gy (1997) A formáról (About the form). LángKiadó, Budapest.

Papanek VJ (2005) Design for the Real World. Academy Chicago Publishers, Chicago, U.S.A

*** (2014) "Failure Mode & Effects Analysis (FMEA) Tutorial", MoreSteam University, MoreSteam.com, Online at: https://www.moresteam.com/toolbox/fmea.cfm