

Towards a Systematic Evaluation of Web Design

Ivayla Trifonova, Naoum Jamous, Holger Schrödl

Abstract—A good web design is a prerequisite for a successful business nowadays, especially since the internet is the most common way for people to inform themselves. Web design includes the optical composition, the structure, and the user guidance of websites. The importance of each website leads to the question if there is a way to measure its usefulness. The aim of this paper is to suggest a methodology for the evaluation of web design. The desired outcome is to have an evaluation that is concentrated on a specific website and its target group.

Keywords—Evaluation methodology, factor analysis, target group, web design.

I. INTRODUCTION

NOWADAYS almost every company or organization has a website. An excellent design of these is key for a good representation of each business. Web design includes the optical composition, the structure, and the user guidance of websites [1]. However, it has many perspectives. Aside from the aesthetics and the concept, other perspectives of web design are the user friendliness and features connected with the operation alternatives [1].

The most information that can be in the form of text, picture, sounds, or films/animations on the Internet is located on websites [2]. The importance of internet presence cannot be neglected. Most people use the web almost every day in order to inform themselves about different themes. For every user of the website, it is important to find well-presented information that he finds in a timely manner [3].

So the key question is: What does an excellent website look like, and what is meant by “excellent” in this context? To consider this, there are many sub-questions like: What are the optimal amount of pictures and how should they be positioned? What is the optimal amount of text so that the reader can accept it in the best way? What is the proper navigation?

On the one side, effective design is a combination of experience, surprise, and a feeling of comfort. On the other side, it is a good orientation, functionality, and shopability [4]. It is important that every owner of an internet page satisfies the target group [5]. The work of Hansjörg Zimmerman in the area of usability of offers on the Internet shows what can be the consequences of a poorly created web page [5]. He gives

Ivayla Trifonova and Holger Schrödl are with the Institut für Technische und Betriebliche Informationssysteme (ITI), Otto-von-Guericke-Universität Magdeburg (OVGU), Magdeburg, Germany (e-mail: ivayla.trifonova@st.ovgu.de).

Naoum Jamous, is with the Institut für Technische und Betriebliche Informationssysteme (ITI), Otto-von-Guericke-Universität Magdeburg (OVGU), Magdeburg, Germany (phone: +49-391-67-51927; fax: +49-391-67-11216; e-mail: naoum.jamous@ovgu.de).

as examples for typical mistakes, done during the creation of an internet page: not visible navigation, too long and not structured texts, not successful effect of the colours on the monitor, and lack of adaptation of the website to the target group. Those items lead to confusion of the user, and do not motivate him to visit the site again [5]. This is proof of the importance of the orientation of web design in such a way so that the target group can be satisfied. However, how can be the customer’s satisfaction with a website measured? From that follows the scientific research question: Can web design be evaluated with the help of an algorithm or systematic analysis?

II. STATE OF THE ART OF WEB DESIGN

There are a lot of online tools for web design evaluation such as WDG HTML Validator, Websitegrader, Seitwert, and much more. However, those only examine the technical perspective of the product. The design of a web page should be adapted to the target group in every aspect [3]. From that follows the difficulty about web design evaluation, and this is exactly the dependency on the target group. Every nationality, age, job, and gender group has its own preferences. Another point is to keep the function of the internet site in mind: business card, E-Business, E-Commerce, and so on.

As a motivation for the development of an evaluation methodology for web design, the empirical results of M.Thielsch and R. Jaron highlight the importance of aesthetics for the perception of websites [6]. They divide the perception of websites in three main dimensions: contents, usability, and aesthetics.

Their survey about the importance of these dimensions shows that contents are on the first place, then comes usability, and on the last place is aesthetics. This is what the user said when he was directly asked about his opinion and had time to think about it. Other statements can be made as a result of laboratory experiments [6]. There is a strong correlation between each of the three dimensions and the first sight and the general impression of a website. The conclusion of this contribution is that all dimensions of an internet site should be paid attention to. It is important to provoke the interest in the beginning in order to have a better chance for more visits in the future. In this phase, aesthetics is a strong influence factor. In the next phase - repeated visit, the usability and the contents have an important role [6].

In general, there are six components in which the creation of a website can be divided [7, p. 20]:

A. Orientation

The user sees with the help of orientation elements in which area he is moving and which themes can also be chosen [8]. The point is to define the structure clearly and then to evaluate if it is effective or not.

B. Navigation

The clear and effective navigation structure and information structure are one of the most important success factors for a website [8]. In this part, the movement on the webpage is discussed.

C. Information Presentation

Information is delivered to the user with the help of the contents on the internet site. It is important how the information is presented. When we talk about web design, the point is not the contents themselves, but in which way they are given to the user. The understanding is much more connected to the form and the structure of the text as to the text itself. A reader-friendly text requires a good, readable font on the monitor, a clear structure, and short and concise sentences [8]. The pictures as a part of the website are also ordered in the component information presentation. The reason is that pictures boost the meaning of the text. They can also make the understanding of the information easier. Pictures can be divided in three categories [7] p.102. Those with illustrative function are directly connected to the text and illustrate it. The ones with structural function serve as an explanation of the structure of the website. The last ones have a decorative function [7, p. 102]. They are also almost always connected to the text, but they do not explain the contents. They are there to give an aesthetic boost. All three of these examples can be found on al-most any website and no one of them should be neglected because they are all part of the visual perception.

D. Screen-Layout

Screen-layout includes the proper monitor presentation of the contents of one website and the design composition of all used elements [8]. Layout is important for the perception of a particular website. The way that the different elements are positioned and presented can make the user feel secure [8]. With the help of screen-layout, you can make your target group trust you [8], and this is the best way to win customers. The colors are an important part of the screen-layout and visual representation. Colors play a considerable role in people's perception [7, p. 138]. Interpretation of different color tones is influenced by culture and personality, and that is the reason why people are not able to percept colors without emotion and neutral [7, p. 138]. Due to this fact, they should be adjusted to the purpose of the website. No general statement can be made to the color concept because of the strong cultural influence. For this reason, colors should always be adapted to the target group.

E. Interaction

Interaction elements make it possible for the user to actively participate. Every action of the user should have a reaction. Typical dialog elements are navigation toolbars, searching functions, online forms, and others [8]. The importance of this component is that the user gets the feeling that he can control the process of usage and make it suit his needs.

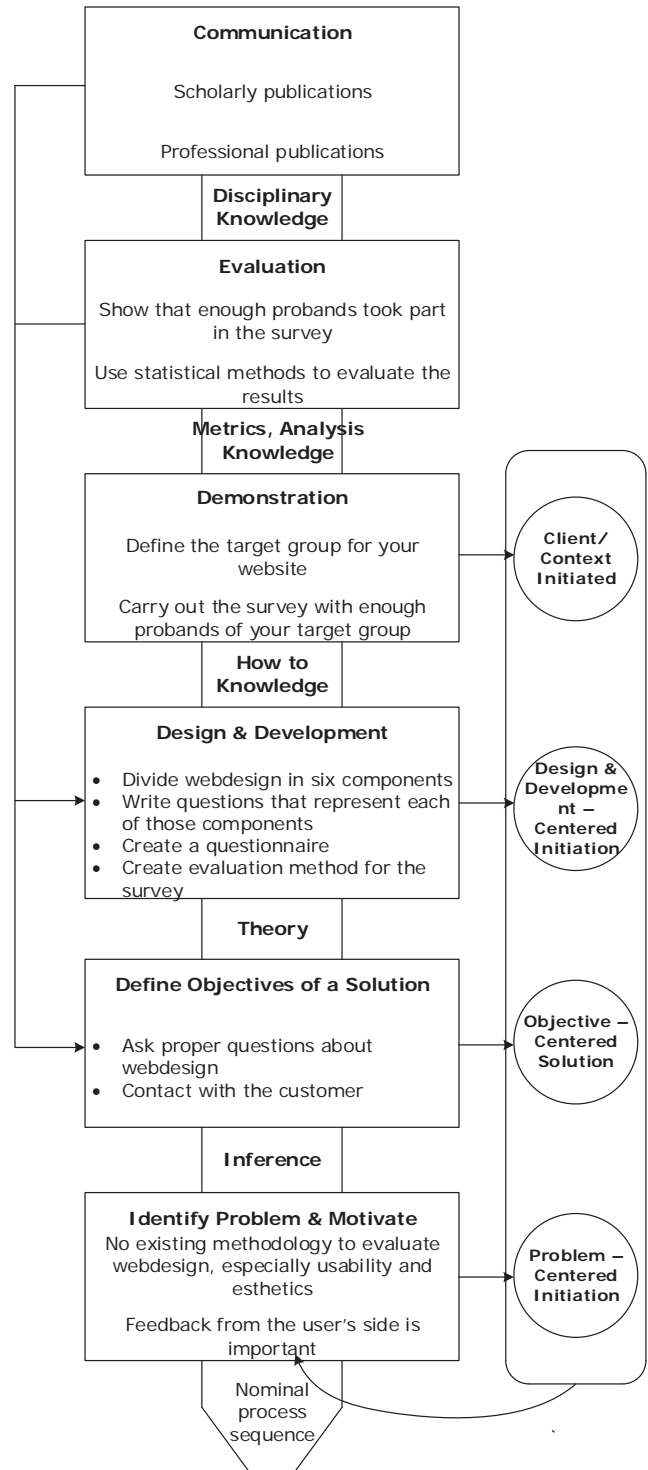


Fig. 1 Research approach [9]

F. Motivation

A product is motivating when it is adapted to the target group, intuitively usable, and clearly constructed; it offers useful information and addresses the user in the proper way [7, p. 179]. Moreover, motivational elements make the usage of the product easier and more effective. Motivation can be associated with effectiveness and user friendliness. An-other point is that this component of websites has the role to

differentiate the product from the concurrence [7, p. 179].

III. APPROACH

Fig.1 gives an overview of the suggested approach in this paper. The motivation of this paper was to solve the problem following the suggested approach. The problem was identified as the lack of systematic methodology for web design evaluation in such a way so that the result corresponds with the opinion of the users. The purpose is in the end to have a feedback, which comes directly from the target group. The three general parts of the suggested approach is the creation of a survey, the carrying out the survey with enough probands, and an analytical technique for the results.

IV. SURVEY

The basis of the suggested approach is a quantitative research method. The idea is to use a survey to evaluate the different components and the website as an end product. After that, a factor analysis on the results can be conducted in order to gain more knowledge about the meaning of the results.

The first step is the choice of test people. They should be such people the probability of them using a website is large. Criteria that can describe the test people can, for example, be: age, gender, job/occupation, hobbies, nationality, income, etc. A detailed description of the websites target group should be made. The example presented in this paper is the website of a faculty in a German university. In this example, the most important criteria in order the test people to be chosen is job/occupation – university employee, student or interested in studies. Other criteria that interesting for the evaluation of the results are age, gender, and field of study.

The second step is the creation of the questions. They are based on the important criteria about the pro-bands and on the six components of web design that result from the theory about those. The ready questionnaire, which was used for the example and suggested as a sample, can be found in the appendix. Those questions were asked to every test person in the form of a survey. There is a scale for every question as an answer opportunity. The questions are made in such a way that a grade can be given as an answer. (1 is for not good or not corresponding and 5 for good or corresponding by the particular website). The idea is at the end to have one general grade for the whole website.

After the creation of the questionnaire comes the problem of how important the different components are. Is the role of the navigation just as significant as that one of screen-layout, etc.? If you assume that all the components have the same importance, then you will have not end up with an objective grade. No general statements as to the weighting ratio of all the components can be made. Depending on the type of the website, the pictures can be more important than the information. The way to find out the weighting ratio is to ask about how important every component is for the user. These questions also have as an answer opportunity a scale (1 is not important and 5 is really important.)

When all these steps are done comes the time for

conducting the survey. In order to do so and gain plausible results, we need to know the required minimal number of test subjects. The calculation is carried out with the help of the formula for minimum required sample size for a finite population [10].

$$n \geq \frac{N}{1 + \frac{(N-1)\epsilon^2}{Z^2 \cdot P \cdot Q}} \quad (1)$$

N is the size of the whole population and n is the minimal required sample size. ϵ is the chosen tolerated mistake of the results. Z is to be implicated from the standard normal distribution as the security percentage chosen by us. P is the average of the population, which means the percentage of the people that are actually able to take part in the survey. Q is at the end calculated as 1-P.

TABLE I
 COMPONENTS GRADES CALCULATION

	Sum	Questions	Maximal possible sum	Percentage	Grade
Orientation	1881	5	2625	71,66%	3,58
Navigation	1440	4	2100	68,57%	3,43
Information Presentation	2431	6	3150	77,17%	3,86
Screen-Layout	2023	5	2625	77,07%	3,85
Interaction	1484	4	2100	70,67%	3,53
Motivation	1462	4	2100	69,62%	3,48

The survey that we have conducted is about the website of one faculty in a German university. From this fact automatically follows that we have to deal with a finite population – the number of students, matriculated at this faculty. The size of our population is 1076. We take as a tolerated mistake the normally used number - 0, 05 and as a security percentage - 92%. The value of the standard normal distribution function is 92, 97 % (0, 9297) for the input 1, 81 for z [10]. For P we just approximate 0, 9, as we suppose that 10% of the students are not actively studying anymore or are currently not in the country. The minimal number of required pro-bands that is calculated and rounded up with (1) is 105.

TABLE II
 COMPONENTS WEIGHTING RATIO CALCULATION

	Sum	Percentage
Orientation	447	18,34%
Navigation	450	18,47%
Information Presentation	445	18,26%
Screen-Layout	388	15,92%
Interaction	361	14,81%
Motivation	346	14,20%
	2437	

V. ANALYSIS OF THE RESULTS

The analysis is done in two steps - by using Microsoft Excel and the R software for Statistical Computing.

A. Analysis with Microsoft Excel

The analysis with Microsoft Excel is carried out in three

general stages.

The first step is to work on the results from the questions about the six components of web design. These are presented in Table I. First, all the evaluations for each component should be summed. This number should then be written down in the column Sum and the respective row. In the next column – number of questions, should be the number of the asked questions to every component noted. The next thing to be done is to calculate the maximal possible sum of all the evaluations for every component. It is a multiplication of the number of questions that were asked, the number of test people and 5 (the best possible grade). The column percentage corresponds the proportion of the sum of grades from the maximal possible evaluation. As last should be a grade for every component calculated. It is the respective percentage that is already calculated from 5 (the highest grade).

TABLE III
END GRADE CALCULATION

End grade	3,62600139
-----------	------------

The second step concentrates on the weighting ratio of the different components of web design. First, all the weighting numbers that were given for every component should be summed. After that, these taken altogether should be summed. At the end, the proportion of the sum for each component from the general sum is to be calculated. This number represents how a grade of each component should be taken proportionally for the end grade. The result can be obtained from Table II.

The last step is the calculation of the end grade. The grade for each component should be multiplied with the respective weighting proportion. The sum of these six multiplications is the general grade for the website. The end grade of the carried out survey in the university can be seen in Table III.

The usage of the analysis with Microsoft Excel is to find out the basic statistics. This method gives information about the average grades of the different components of the website and also about their average importance. The end grade itself is a representation of the general impression that the users have of the website. Using this data can help the owner of a particular website to make basic conclusions about the quality of his product.

B. Analysis with R software for Statistical Computing

A more detailed evaluation of the results can be conducted with the help of a factor analysis. It is based on statistical methods, and aims to represent a set of variables as a smaller number of hypothetical variables [11]. The general course of factor analysis is based on calculation of the interrelationships between these variables. If particular sets of these have higher positive correlations, then they can be united in one hypothetical variable [11]. The major steps of this method are: selecting the variables; computing the correlation matrix of those; extracting the not rotated factors; rotating those; and interpreting the rotated factor matrix [12]. The results of the factor analysis make the underlying structure of the data clear and help us to find out the influences causing the discovered

patterns [13].

In the case presented in this paper, the factor analysis is an option to get a detailed view of the results of the conducted survey. The aim of using this type of evaluation is to make a better description of our probands as we generate a new one from the existing date. Another possibility is to see how the average grades of the different components correlate with each other.

With the help of the R programming language, a factor analysis was carried out on the results. The gathered data was processed in order to get a proper input table for the analysis. Instead of using the answers to all the questions, the average values given from every test person were calculated for each component. The information for the gender, nationality, and field of study of the probands was represented with numbers in order to enable analysis.

When the input data has been processed, then comes the time for the implementation of the methodology. We chose to use the methods *fa* and *nfactors*, which enable the conducting of an exploratory factor analysis [14]. “Exploratory factor analysis (EFA) is a method of determining the number and nature of unobserved latent variables that can be used to explain the shared variability in a set of observed indicators, and is one of the most valuable methods in the statistical toolbox of social science” [15]. Important input parameters for the *fa* analysis are the factoring method (*fm*), the rotation method, the usage of squared multiple correlations (*SMC*), and the number of factors to be extracted (*nfactors*) [14]. We use the default values as rotation method – *oblmin*, and *SMC* = *TRUE* [14]. As a factoring method we take the one shown in the example – *minres*, which does a minimum residual. In order to know how many factors have to be extracted, we use the method *nfactors*. The input parameters for that one are the same as for the factor analysis. Another required input is the fitting of the diagonal, which we do not necessarily need and therefore set as *false* [14]. The second important parameter is the number of factors as input, which is 16 according to our input [14]. After conducting the *nfactors* method we got more than one suggestion for the number of factors to be extracted. We chose 3 factors because this value is the result of three of the possible algorithms to conduct the *nfactors* methods - Very Structure Criterion, Wayne Velicer’s Minimum Average Partial (MAP) criterion and *eBIC* (The empirically found BIC based upon the *eChiSq*) [14]. The results of the *nfactors* method can be seen in Fig. 2.

After that step, the factor analysis can be carried out with the number of factors to be extracted – 3. The results from the factor analysis can be seen in Fig. 3.

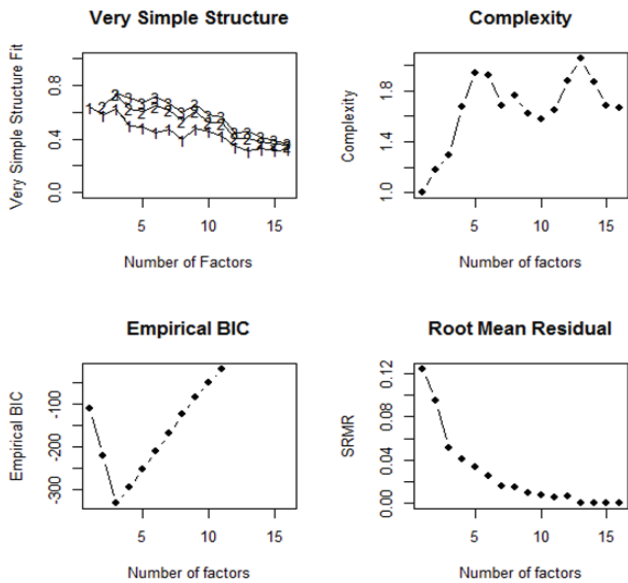


Fig. 2 Results of the nfactors method

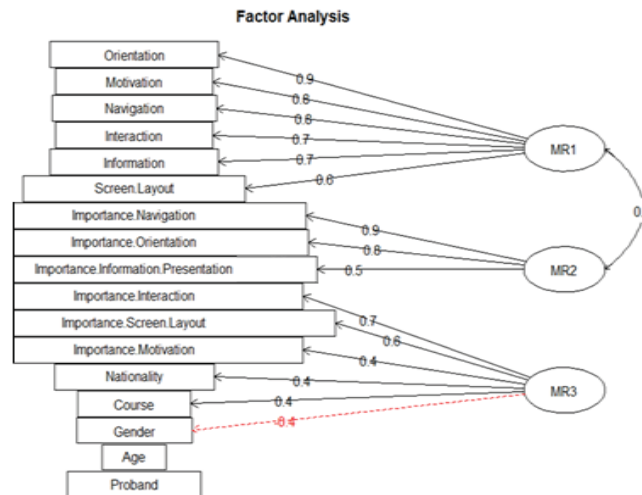


Fig. 3 Results of the factor analysis

VI. OUTLOOK AND CONCLUSION

The suggested method was to evaluate web-design so that the results come directly from the target group. Web design was divided into six components, and questions were created for each component. These together with some statistical questions about the test people build a survey, which should be conducted with the required minimal sample. For the analysis of the results, a method was developed. As an example of the approach, the suggested survey at one faculty of a German university was carried out. From this evaluation result the following advantages, disadvantages, and still open questions can be observed.

The survey in general is a method that is often used. It is also proper for the assessment of web-design. Its advantage in comparison to technical tests and consultation with experts is the feedback that comes directly from the target group. This method, the same as every other, also has its disadvantages.

What can be concluded from that diagram is that the opinion of the test people about one website can be seen as one factor. This means that the evaluation of one specific product cannot really be divided in components because those correlate strongly with each other. The importance of navigation, orientation, and information presentation are another important factor. Those can be interpreted as a sign of understanding the website and being able to use it. This factor is not connected with any specific information about the user because for every product a person is interested in, it is important to be able to use it effectively. The third factor in our case consists of the importance of interaction, screen layout and motivation, and the nationality, gender, and study course of the probands. What can be interpreted from that one is that the design and the user-winning features of one website correlate with the basic data about the test people. The importance of design depends strongly on the type of people that took part in the survey.

Those can be formulated as open questions for the future.

The presented analysis of the results can be used to calculate general grade, grade of the components, and interdependencies of the data. However, how can you be sure that these numbers are plausible and that every participant has done the survey carefully? Can this problem be solved with the usage of some specific questions or is there another technique that motivates the test people to fill the questionnaire attentively?

As previously mentioned, one of the advantages of the survey is the contact with the target group. However, if we have to deal with a big population, it will be a lot of effort to use that type of analysis. Is there a way to optimize the process of carrying out the survey and processing the results of it?

These questions are part of the area: Method to create and carry out a survey properly. The answers to those later will be an improvement for the now suggested approach.

APPENDIX

TABLE IV
 EVALUATING THE FIN WEBSITE: BASIC QUESTIONS

Age	Gender
Study course	Nationality

TABLE V
 THE WEBSITE ORIENTATION

You always know on which page of the website you are
The website structure is clear
You can always retrace the course of your visit (session)
You can always be sure that you visited the right page of the website
You can find the needed information fast

Please note that 1 is a value for not corresponding and 5 for corresponding.

TABLE VI
 THE WEBSITE INFORMATION PRESENTATION

The font size is easy to read
The font type is easy to read
On each page of the website, the contents are well structured and easy to follow
The sentences are short, understandable and expressive
Pictures and diagrams are connected to their contents
The pictures and diagrams are supportive

TABLE VII
 THE WEBSITE INFORMATION PRESENTATION

The font size is easy to read
The font type is easy to read
On each page of the website, the contents are well structured and easy to follow
The sentences are short, understandable and expressive
Pictures and diagrams are connected to their contents
The pictures and diagrams are supportive

TABLE VIII
 THE WEBSITE SCREEN-LAYOUT

The composition of the different elements on the website is successful
The website's pages are following the same template
The colors are appropriate for a university website
The colors have a harmonic influence together with the contents
The website has an esthetic look

TABLE IX
 THE WEBSITE INTERACTION

The website has an effective searching engine
When you click on an object on the website, you always receive the proper answer
The website response time is good
The website's dialog elements are functioning properly

TABLE X
 THE WEBSITE MOTIVATION

The website is useful
The website is intuitive
The website is user friendly
Compared with other similar websites, the FIN website can be differentiated (positively)

TABLE XI
 HOW IMPORTANT ARE THE FOLLOWING COMPONENTS OF WEB-DESIGN FOR YOU?

Orientation
Navigation
Information presentation
Screen-Layout
Interaction
Motivation

ACKNOWLEDGMENT

The authors sincerely thank Dr. H. Schrödl for his support and advices.

REFERENCES

- [1] H. Balzert, U. Klug und A. Pampuch, *Webdesign & Web-Usability. Basiswissen für Entwickler.*, Bd. 2, W3L GmbH, 2009, p. 3.W.-K. Chen, *Linear Networks and Systems* (Book style). Belmont, CA: Wadsworth, 1993, pp. 123–135.
- [2] H. Klein, „Inhaltsanalyse von Webseiten. Probleme und Lösungsansätze“ 1999.
- [3] T. Hauser, F. Maurice und C. Wenz, *Das Website-Handbuch: Programmierung und Design*, Germany: Markt+Technik Verlag, 2009, pp. 66-68.
- [4] C. Gerdes, J. Nachtway und C. Vilanek, *Cybershop. Schöner einkaufen im Netz.*, Schmidt, 2000, p. 35.
- [5] H. Zimmermann, „Usability – Die Kunst Mensch und Maschine auf einen Nenner zu bringen.“ *Stuttgarter Beiträge zur Medienwirtschaft*, Nr. 10, pp. 9-19, 2004.
- [6] R. Jaron und M. T. Thielsch, „Die dritte Dimension: Der Einfluss der Ästhetik auf die Bewertung von Websites.“ *Planung & Analyse*, Nr. 1, pp. 22-25, 2009.
- [7] F. Thissen, *Screen-Design-Handbuch: Effektiv informieren und kommunizieren mit Multimedia*, 2 Hrsg., Berlin: Springer, 2001.
- [8] B. Metzeler, *Interkulturelles Webdesign - dargestellt anhand von Beispielen der internationalen Automobil- Branche*, F. S. –. H. d. Medien, Hrsg., Stuttgart, 2002.
- [9] K. Peffers, T. Tuunanen, M. Rothenberger und S. Chatterjee, „A Design Science Research Methodology for Information Systems Research,” *Journal of Management Information Systems*, Nr. 24, pp. 45-77, 2007.
- [10] I. Mossig, „Beiträge zur Wirtschaftsgeographie und Regionalentwicklung.“ Bremen, 2012.
- [11] J.-O. Kim und C. W. Mueller, *Introduction to Factor Analysis. What it is and how to do it*, United States of America: SAGE Publications, 1978.
- [12] A. L. Comrey und H. B. Lee, *A First Course in Factor Analysis*, Bd. 2, Lawrence Erlbaum Associates, 2009.
- [13] R. J. Rummel, *Applied Factor Analysis*, United States of America: Library of Congress, 1970.
- [14] W. Revelle, „Procedures for Psychological, Psychometric, and Personality Research“ 2014.
- [15] K. J. Preacher, G. Zhang, C. Kim und G. Mels, „Choosing the Optimal Number of Factors in Exploratory Factor Analysis: A Model Selection Perspective,” 2013.