Future Chances of Software Customization: An Empirical Evaluation

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***Abstract*—Customization is an important market trend because companies can only survive when they focus on their customers' needs. In order to offer demand-driven customization options, it is necessary to empirically analyze the benefit of the various adaptations from a customer's point of view. In the software sector, only a few surveys have been conducted that exceed technical aspects. Moreover, existing studies are limited to the overall acceptance and benefits of customization, but draw no conclusions on different adaptation options. Thus, we present a large study that analyzes the starting points of software customization and deals with general questions of customization. The results indicate that software customization increases the willingness to pay (WTP) by about 15%. The survey points out that especially customization options, which adapt the functionality, increase the usability, and enable parental controls are of great importance for future software implementation. Hence, our results enable competitive advantages by implementing customization options that meet customer needs.**

Keywords-customization; adaptability; tailoring; user study; human-computer interaction.

I. INTRODUCTION

Today, competitive pressure and customer empowerment change selling conditions. Customers are no longer willing to accept the *customer sacrifice* [1], [2], the gap between products offered and customer needs. That is why the *long tail phenomenon* [3], [4] starts to rule the market and a multitude of tiny niche markets replaces traditional mass markets. Hence, producers turn from selling off-the-shelf products to offering customization. Åhlström and Westbrook [5] have shown that the demand for non-standard products is even growing and producers plan to increase customization.

This trend can also be seen in the software sector. *Software product lines (SPL)* help to build software that satisfies a specific market segment on the basis of a common set of core assets [6]. However, accessibility movements and the regulation by law demand an even stronger focus on the individual (cf. Section 508 of the *Rehabilitation Act* [7] and the *German Equality Law For Disabled People* [8]). However, accessibility is not the only reason for software customization. The *International Standard on Ergonomics of Human System Interaction* (ISO 9241/110) indicates that customization is an important principle to design a dialog. The *Technical Report on Software Engineering* (ISO/IEC TR 9126-2) even says that customization is a requirement of software quality that helps to meet the user's needs. Software customization could also enhance the customer experience [9]. Thus, customization is a crucial part in current software engineering.

There are various ways to customize software. The *DUFS* customization classification [10] organizes this richness and helps us to outline software customization. This categorization subdivides *design customization*, *usability customization*, *functionality customization*, and *customization of service and communication*. In this context, design customization means an adaptation of the appearance of the *Graphical User Interface* (GUI). As companies can only prosper if they focus on their customers, software developers need to know which customization features are in demand. A previous empirical study [5] cites this lack of knowledge of customer needs as the major difficulty in customization.

Nevertheless, existing studies often only focus on non-software vendors and software customization surveys are limited to technical aspects. Thus, we conduct a comprehensive survey. This paper elaborates on the small excerpt presented in a previous paper [10]. The detailed results on customization enable an in-depth analysis of customer evaluation. Hence, customer opinions of customization in the non-software sector as well as in the software sector are considered and future chances are identified. To our knowledge this survey is the largest one in terms of software customization and the only one that considers customization starting points. Thus, our study helps software developers to decide on customization implementation and provide adaptations that are valuable for their customers.

In the following, Section II summarizes previous surveys on customization and explains why analyses of non-software customization provide valuable insights that could be used for software customization. Section III introduces our study and illustrates the methods used. Afterwards, Section IV presents the non-software analysis and spotlights customization usage. The results of the software customization investigation are presented in Section V. Before concluding, Section VI critically examines the survey.

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II. Background and Related Work

The beginnings of customization go back to 1987, when Stanley Davis introduced a business strategy to implement customization called *Mass Customization* (MC) [11]. In 1993, Joseph Pine made this strategy popular [12]. From then on, the trend of customization spread. The following lists the most important studies on customization in the non-software sector as well as in the software sector. Additionally, the section shows why findings of non-software products could be valuable for software products.

A. Non-Software Products vs. Software Products

Kotler and Armstrong described a product as "anything that can be offered to a market for attention, acquisition, use, or consumption that might satisfy a want or need" [13]. Additionally, Peter Dracker stated that a company can only prosper if it focuses on its customers and their needs [14]. Consequently, the customer's perception of the product and its value determines the company's success.

According to Kittlaus and Clough [15], the value that comes out of the intangible product software can only be realized in its functionality. However, the emergence of appearance customization in software, e.g., the tailoring of forum appearances, shows that software is more than something to get things done. Thus, there are similarities in customer perception between non-software and software products, even though they differ greatly in characteristics.

Due to the importance of customer perception, we believe that findings from the non-software area in terms of perceived customization could be valuable for the software sector. This practice is useful since the non-software sector has a much longer history and many people see software as incomprehensible "black magic" [16]. Thus, non-software products are well-known to a wider audience whereas software knowledge could still be limited.

In contrast to non-software products, many software characteristics support its customizability. Software has no physical form and belongs to the economic factor of *knowledge* [15], [16]. This makes later adaptations easier and enables repeated customization. As Frederick Brooks said, this easy adaptability obliges software vendors to offer adaptation options [17]. Besides, the delivery of software is simple, fast and could be made on an individual basis. These facts facilitate software customization.

B. Previous Studies on Non-Software Customization

To address customer needs it is important to know which product features create value from a customer's point of view. As only customers can answer this question properly, many surveys have been conducted. Unfortunately, many of them only consider non-software products [18], [19], [20]. Piller et al. [21] listed existing studies of MC and highlighted especially the additional contribution that could be achieved with the help of customization. By offering shoes that are adapted in terms of fit, function and design, the sporting goods producer *Adidas*, e.g., achieved 30 to 50% higher prices [21], [22]. However, in 1998 Huffman and Kahn [23] empirically documented problems in information retrieval.

C. Previous Studies on Software Customization

Despite the fitness of software for customization few studies analyze general aspects of software customization. The most important one was made in 1991 by Mackay [24]. She observed the triggers and barriers of software customization. According to her, the main triggers are the reusing of repeated patterns, the retrofitting after a system change, and the avoidance of annoying behavior. In contrast, barriers are a lack of time and knowledge. In 1996, these results were proven by Page et al. [25].

Most existing studies on software customization only consider technical aspects. Many authors compared the three methods of software customization. *Adaptable initiatives* are based on the self-customization of the user. Moreover, in the non-software area it is also quite common for manufacturers to adapt the product to the customer's needs. In the software sector this can be done by the software itself. This method is known as *adaptive initiative*. Additionally, software could use a *mixed initiative* which combines both aspects. Thus, several studies tried to identify the best practices for designing menus [26], [27] or GUIs [28], [29], [30]. Furthermore, research is done to analyze accessibility aspects [31], [32]. These studies verified the benefits of software customization. With regard to quantitative aspects, an increase in performance and decrease in error rates could be measured. Moreover, improvements in qualitative aspects, such as usability, stress in usage, and individual preferences, became visible. The increase in user satisfaction, a software quality requirement (cf. ISO/IEC 25051:2006), was empirically verified in a study on *Apache Security Software* [33]. However, its validity was limited by only interviewing skilled users.

The financial effects of software customization have been studied by Oliver et al. [34]. They found that 5 to 10% higher profit margins and doubled revenues could be realized.

All existing surveys on the subjective advantages of software customization focused on overall feelings but no conclusions on the acceptance and benefit of particular customization features could be drawn. Thus, we conducted a large study that used the DUFS customization classification [10] to analyze customer perception on different customization options. DUFS sub-divides software customization into four categories. *Design customization* sums up all options that help adapt the interface's appearance according to the customer's preferences. *Usability customization* refers to adaptations which make the software more effective, efficient and task satisfying (cf. DIN EN ISO 9241 Part 11). All customization options that help close the gap between offered and needed functionalities belong to the category of

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TABLE I. PROFESSIONAL DISTRIBUTION

Profession	Participants	
Job Applicant	8	2.92%
Scholar	26	9.49%
Trainee	12	4.38%
Student	59	21.53%
Employee	94	34.31%
Operative	12	4.38%
Executive	36	13.14%
Self-employed	20	7.30%
Senior Citizen	7	2.55%
Sum	274	100%

functionality customization. Customized auxiliary services and customized software messages and greetings are part of *service and communication customization*. By using this categorization and involving heterogeneous user groups our survey gives detailed insights into the appraisal of software customization. Additionally, it deals with general questions on customization to form a basis for in-depth research.

III. METHODS

Our empirical study analyzes customization from a customer's point of view. All values in the text are rounded off to two digits after the decimal point.

A. Data Collection and Sample

As previously outlined [10], the study was conducted in 2010 in South Germany. The answers of ten interviewees could not be used because of missing data. Thus, the study includes the answers of 274 participants. 43.43% of them are female. The sample includes heterogeneous participants (cf. Fig. 1 and Table I). The survey could be completed either electronically (20.44%) or in paper form (79.65%).

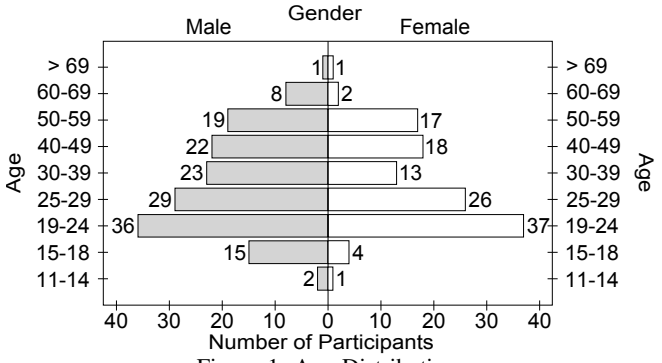

Figure 1. Age Distribution.

The sample is slightly different to the whole German population because of the proximity to the University of Ulm. It includes comparatively many young, well-educated participants and male opinions are somewhat overrated. However, the large and heterogeneous sample allows conclusions to be drawn on perceived customization.

B. Participant Grouping

Two participants had never used a computer before, so the sample size for the computer-related questions is 272. For analysis purposes these participants were divided into *frequent users* that use their computer daily and perform at least five different tasks and *non-frequent users*. The study contains data of 175 frequent and 97 non-frequent users.

IV. CUSTOMIZATION USAGE AND REASONS

The survey started with non-software customization to facilitate access and ensure the quality of the given answers. Additionally, it helps to get elementary insights into customization. These results are pointed out in the following.

A. Customization Usage

In order to analyze customization usage we subdivided non-software products into the categories *clothing and shoes*, *vehicles and bikes*, *grocery and beverages*, *stationery*, *souvenirs*, *jewelry*, *health care*, as well as *electronic articles*. The survey gave examples of customization in the different categories. This helped to ensure that all participants could properly answer if they had ever used customization in these categories. Fig. 2 illustrates the results.

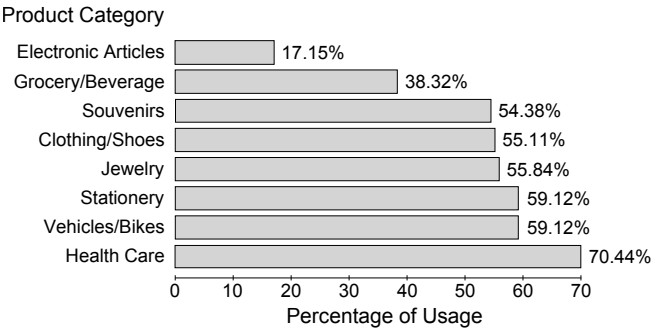

Figure 2. Customization Usage.

The overall usage rate of 51.19% supports customization research. Besides of adaptations of electronic articles, grocery and beverage, customization usage is quite common.

Analyses of the adaptation starting points with the help of the *DEFS* customization categories *design*, *ergonomics and fitting*, *functionality*, as well as *services* [10] show that in most of the product categories adaptations are generally minor variations in design. These adaptations are used with clothing and shoes, vehicles and bikes, grocery and beverage, stationery, souvenirs, jewelry, and electronics. Nevertheless, products with adaptations to increase the ergonomics and fitting are also available. In the health sector these adaptations are necessary to cope with the customer-specific body. However, even clothes or shoes are adaptable in terms of ergonomics. Thus, e.g., the sporting goods producer *Adidas* offers ergonomically adaptable shoes. Above all, the categories vehicles and bikes as well as electronic articles offer ways of adapting the functionalities by adding adequate modules. In contrast, service customization is only rarely available in the *Business-to-Consumer* (B2C) sector.

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B. Reasons for Customization Usage

The survey tried to get an insight into the reasons for the named customization usage. The participants had to state if they use customization to *adapt the functionality*, *adapt the design*, *highlight individuality aspects*, or *participate in a future trend*. They also got the chance to say they see *no benefit* in customization. This question was semi-open and multiple answers were allowed. Fig. 3 lists the results.

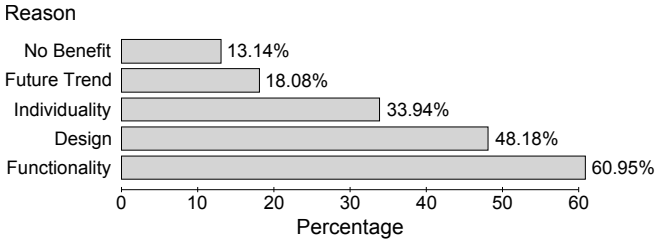

Figure 3. Reasons for Customization Usage.

According to the participants, the main reason for customization is to adapt the functionality. Another frequently named reason is design adaptation. The enhancement of one's individuality which rests on a human basic need was also seen as a major factor. Moreover, only 13.14% of the participants see no benefit in customization. In contrast, 18.08% judge customization as an important future trend. This justifies the importance of this paper's topic.

The free-text answers showed that customization is used to possess something unique, increase the imaginary value, differ from the mass, and give presents. The participants also revealed the importance of value for money aspects.

Since the female and male answers differ, we did a Chi-Square Test ($\alpha = 0.05$) to analyze this. Table II shows that only the fact that the women use customization more often to highlight their individuality (41.18% vs. 28.39%) could be traced back to gender.

TABLE II. CHI-SQUARE TEST

H0: The occurrence of a customization reason is independent of gender.

Topic	Pearson's Chi-Square	Degrees of Freedom	Asymptotic Significance (2-sided)	Fisher's Significance (2-sided)
Functionality	3.538	1	0.060	0.063
Design	0.254	1	0.615	0.628
Individuality	4.911	1	0.027	0.029
Future Trend	0.526	1	0.468	0.526
No Benefit	0.017	1	0.895	1.000

V. Software Customization

The second part of the survey examined the usage of existing software customization options, financial benefits for software vendors, and future chances.

A. Usage of Software Customization

In order to get meaningful results on the perception of existing software customization options, we chose features that are well-known to participants of all age categories. The participants rated 15 adaptation options in the areas *operating systems*, *Office products* and *world wide web*. All but one are adaptable options because users take more notice of self-made changes than of automatic ones. This increases the reliability of the findings. With regard to usability, we listed the *creation of links*, *creation of bookmarks*, the *quick launch bar* of the operating system, and the *tool bars* of Office programs which all help to get quick access. Usability aspects can also be customized by tailoring the *update handling* and *choosing one's native language*. Existing software offers many features to adapt the design, i.e. the GUI appearance. We chose the adaptation of *fonts*, *colors and contrasts*, *icon size*, *desktop background*, *mouse pointer*, and the *screen saver*. Furthermore, the participants judged the functional customization offered by *iGoogle* and *Windows gadgets*. Since service customization is only rarely available in the B2C sector, we limited our survey to *adaptive purchase proposals* in online shops.

The survey explained each feature to ensure that all participants understood the questions. Afterwards, the participants stated if they knew the customization option and if they had ever used this adaptation. Additionally, they rated the benefit of each option. According to Schwarz et al. scales with zero-to-positive-values should be used to measure the intensity of a single attribute [35]. Thus, we used a scale from *0* to *5* to evaluate the feature's benefit. A value of *5* indicates that it is very useful. In contrast, a benefit of *0* shows that this feature has no benefit at all. Fig. 4 illustrates the results and maps them to the DUFS software customization categorization. It also shows the usage of the customization options. Even though most of the options are well known, some participants did not know several features. We excluded these participants to calculate a meaningful percentage of usage. The strong correlation (Pearson's r = 0.87) between benefit values and usage highlights that the customer's view is of crucial importance in terms of customization research.

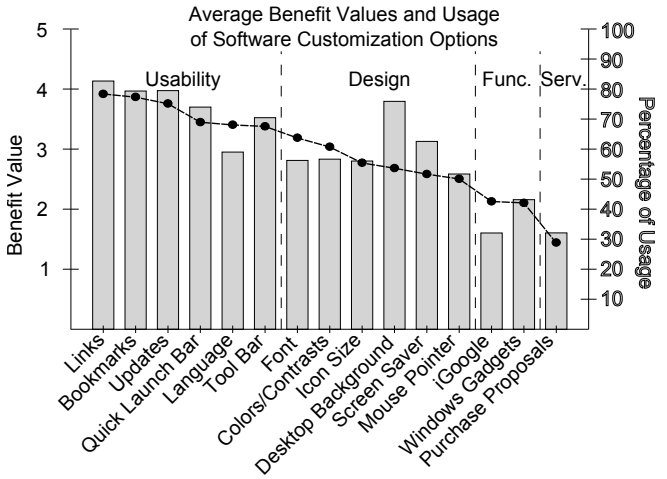

Figure 4. Benefit and Usage of Software Customization.

The mapping of the named customization options to the DUFS categories shows that usability adaptations in par-

ticular achieved high benefit values. Design customization options are rated with high benefit values, too. In contrast, functionality adaptations as well as adaptations of service and communication are rated particularly low. This might be based on some external factors. In contrast to the long-established examples in the categories usability and design, the specified functionality adaptations are quite new. This negatively influences the knowledge, acceptance and also the perceived benefit. The results of customization usage in the non-software sector verify this argumentation. Functionality adaptations are the main reason named for customization. Furthermore, it has to be pointed out that service adaptations have only been rarely available to date in the B2C sector.

Additionally, our findings show that all evaluated design customization options achieved lower benefit values than usability adaptations. All functionality customization options achieved lower benefit values than design adaptations and service and communication customization options are left far behind. This proves that the DUFS classification categories reflect customer perception adequately.

B. Willingness To Pay

We differ between non-software and software products to examine the *Willingness To Pay* (WTP) and evaluated the additional contribution in comparison to an off-the-shelf product. As our goal was to analyze the general WTP rather than the WTP for a specific product, we chose an hypothetical approach. The analyses of Miller et al. [36] showed that hypothetical approaches could generate mean WTP estimations that do not significantly differ from the actual WTP and could be used to make meaningful management decisions. Our participants had to state if they would pay *not more*, *10%*, *25%*, *50%* more, *double the price*, or *more than double the price* to get a customized product. The latter was quantified by a contribution of 150%. Table III summarizes the results – specified by age and user-group. The WTP of the participants younger than 15 years and older than 69 years are not representative but are listed for completeness.

TABLE III. ADDITIONAL CONTRIBUTION

Age (in Years)	**Non-Software** frequent users	non-frequent users	overall	**Software** frequent users	non-frequent users	overall
11-14 Years	-	*10.00%*	*10.00%*	-	*11.67%*	*11.67%*
15-19 Years	9.55%	26.88%	14.21%	13.18%	18.13%	15.26%
20-24 Years	15.76%	24.29%	17.40%	12.80%	13.93%	13.01%
25-29 Years	20.24%	13.08%	17.64%	21.79%	16.15%	19.55%
30-39 Years	13.64%	12.31%	13.06%	14.32%	11.92%	14.14%
40-49 Years	11.00%	11.75%	11.38%	9.25%	8.75%	9.00%
50-59 Years	13.53%	17.22%	15.28%	17.35%	18.61%	18.00%
60-69 Years	27.50%	7.50%	15.50%	33.75%	11.67%	20.50%
$>$ 69 Years	-	*0.00%*	*0.00%*	-	*0.00%*	*0.00%*
Average	15.69%	15.52%	15.22%	15.69%	13.87%	14.97%

The overall average willingness for an additional contribution in the non-software sector is 15.22% and indicates that there is a broad-mindedness for customization. Other surveys in the mass customization area document an even higher WTP of about 30% and partly 100% [21], [37].

The average contribution of 14.97% in the software sector is lower. The reason for this could be that software is not a daily product for everybody and could seem to be less important. This argumentation is verified by the fact that the average contribution of non-frequent users is 14.90% in terms of non-software products but 13.79% with regard to software. In contrast, the average contribution of the participants with frequent computer usage is in both product categories exactly the same (15.46%). These findings could encourage the assumption that in a world where computer usage becomes increasingly common the WTP for software customization will become more similar to non-software products. Thus, the analysis of non-software products could be valuable for software vendors.

C. Future Chances

In order to evaluate the potential of software customization, the survey contained an appraisal of the perceived future chances. We used the DUFS classification to make a distinction. By adding the subcategory *parental controls* we extended the DUFS category *functionality*. The category *usability* was also further divided by using the subcategories *intuitiveness* and *language*. This enables detailed analyses.

In every category the participants rated the future chances of software customization by evaluating their need for future implementation. The survey highlighted that participants should incorporate adaptable and adaptive adaptations. Once again we used a *0*-to-*5* scale to achieve consistency and support the reliability of the results. A value of *0* marks *no future requirements* whereas a value of *5* characterizes *great future requirements*. Fig. 5 illustrates the mean future requirements and their variances in a simplified *Software Customization Chart* (SCC) [10]. In contrast to a full SCC, we make no distinction between adaptable, adaptive or mixed initiatives.

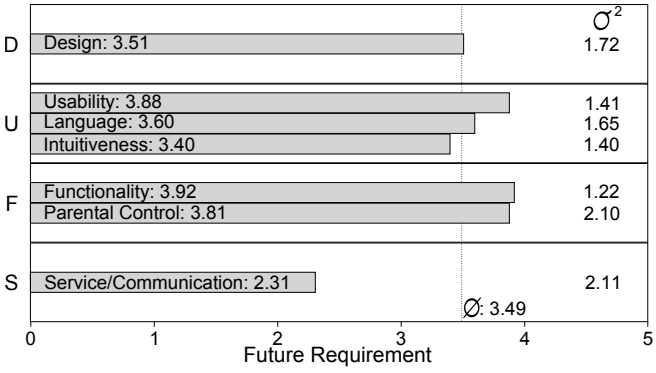

Figure 5. Future Requirement of Software Customization.

The results show that functionality customization in particular achieves high rates and should be increasingly implemented in future software. The participants also highlighted

TABLE IV. T-TESTS ON DIFFERENCES IN FUTURE CHANCES

DUFS Categories	Gender Differences						User Group Differences					
	Leverne-Test		T-Test for a Mean *H0: The average values in the male and female group are the same.*				Leverne-Test		T-Test for a Mean *H0: The average values of the frequent and non-frequent users are the same.*			
	F	Siffgnifi-cance	Uniform Variances $\alpha = 0.05$	T	Degrees of Free-dom	Signifi-cance (2-sided)	F	Signifi-cance	Uniform Variances $\alpha = 0.05$	T	Degrees of Free-dom	Signifi-cance (2-sided)
Design	5.491	0.020	false	-4.355	266.393	0.000	2.213	0.138	true	2.367	270	0.019
Usability	1.333	0.249	true	-1.518	272	0.130	0.953	0.330	true	0.249	270	0.803
Language	2.528	0.113	true	-1.170	272	0.243	1.166	0.281	true	-2.312	270	0.022
Intuitiveness	0.003	0.958	true	-0.573	272	0.567	12.726	0.000	false	3.266	169.419	0.001
Functionality	2.411	0.122	true	-0.613	272	0.540	8.671	0.004	false	1.305	175.428	0.194
Parental Ctrl.	8.780	0.003	false	-3.067	270.760	0.002	0.039	0.844	true	0.125	270	0.900
Service/Com.	0.862	0.354	true	-2.951	272	0.003	0.133	0.716	true	-0.061	270	0.952

great future chances in usability customization. Customization options which enable parental control by limiting the available functionality achieved high support, too. Moreover, the results support the importance of adapting the language of the GUI. The participants also called for an improvement in design adaptations and the intuitive software handling. In terms of service and communication customization the estimations were only moderate. This might be based on the fact that the participants could not evaluate the benefits of service customization because of the low availability in the B2C sector. In summary, an overall value of 3.49 emphasizes the future chances of software customization and highlights the need for further research. Furthermore, the differences in the starting-point evaluation support the DUFS classification.

We performed t-tests to verify the differences in evaluations of female and male participants. The results (cf. Table IV) indicate that the differences in the categories design, communication, and parental controls depend on gender. With regard to parental controls the female rated the future requirement very high (4.10) in comparison to a moderate rate in the male group (3.58). The women also rated the future chances of design adaptations (3.89) as well as adaptations in services and communication (2.61) higher than the men did (3.23 resp. 1.90). In all other categories the differences could not be tracked back to gender.

Further t-tests analyzed the higher valuation of the frequent computer users. Table IV illustrates that the differences in the rating of intuitiveness, design, and language depend on the frequency of computer usage. Fig. 6 shows these differences.

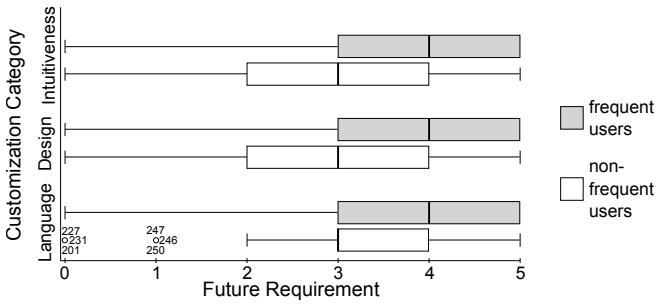

Figure 6. Future Requirement divided by user group.

VI. Discussion

In the following, some threats to validity are considered and the importance of this paper's topic is proved.

A. Threats to Validity

The chosen questions could have an impact on the results and be a threat to internal validity. However, we controlled this by carefully designing the questionnaire, avoiding ambiguous questions, keeping consistency, and using well known examples within the survey. Moreover, we checked the survey in a pretest with five persons.

A potential threat to external validity might be the representativeness. However, the age, the profession, and the expertise of the participants differ significantly and the data set is sufficiently large. To our knowledge, this is actually the largest study of customer acceptance and benefits of software customization. Moreover, it is the only one that evaluates software customization starting-points. Hence, we judge the reported results to be meaningful.

The large sample size also supports the validity of the Chi-Square Test in Section IV. Although, there is only one degree of freedom, the minimal expected frequencies (15.64 to 59.07) are far away from the critical border of ten.

B. Validation of the Need for Customization

The results show that some answers are related to being part of a specific user group, e.g., men or women or frequent or non-frequent users. Yet, many evaluations are based on the user's experience, characteristics, and preferences. This diversity can be seen in the listed variances (cf. Fig. 5). Only customization could cope with these individual aspects.

VII. Conclusion and Future Work

In this paper, we analyzed the acceptance and benefits of customization in the non-software as well as in the software sector. For this reason, we conducted a comprehensive study with 284 participants. Our results showed that customers want customization and are willing to pay a contribution of about 15% for adaptable or adaptive software. The results revealed an overwhelming approval of software customization but indicated unused capabilities in existing systems. The participants use the existing software customization

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options. However, they highlighted that the importance of the adaptation depends on the starting point of the customization. The participants especially emphasized the benefits of adaptations to increase the usability. With regard to future software engineering, the participants called for the improvement of functionality and usability customization options. Moreover, they requested further adaptations in parental controls. Additionally, the findings supported the DUFS customization classification. In summary, the study gave insight into the perception of software customization from a customer's point of view. This could help software developers to detect valuable software customization and provide software that exactly meets customer-specific needs.

For future work, the enlargement of the study could identify cultural impacts on customization perception.

REFERENCES

[1] C. W. Hart, "Mass customization: conceptual underpinnings, opportunities and limits," *Int. J. of Service Industry Management.*, vol. 6, no. 2, pp. 36–45, 1995.

[2] A. Bardakci and J. W. AND, "How "ready" are customers for mass customisation? an exploratory investigation," *European J. of Marketing*, vol. 38, no. 11/12, pp. 1396 – 1416, 2004.

[3] C. Anderson, "The long tail," *Wired Magazine*, vol. 12, no. 10, pp. 170–177, 2004.

[4] C. Anderson, *The Long Tail: How Endless Choice is Creating Unlimited Demand*. Random House, 2010.

[5] P. Åhlström and R. Westbrook, "Implications of mass customization for operations management," *Int. J. of Operations and Production Management*, vol. 19, no. 3, 1999.

[6] P. Clemens and L. M. Northrop, *Software Product Lines: Practices and Patterns*. Addison Wesley, 2002.

[7] *Rehabilitation Act*. United States of America, 1973.

[8] *Gesetz zur Gleichstellung behinderter Menschen (BGG)*. Bundesrepublik Deutschland, 2002.

[9] S. Marathe and S. Sundar, "What drives customization? control or identity?" in *Proc. of the 2011 annual conf. on Human factors in computing systems*, CHI'11, 2011, pp. 781–790.

[10] M. Weiss and N. Heidenbluth, "A two-dimensional overall software customization classification and visualization," in *Proc. of the 2012 Int. Conf. on Software Engineering Research & Practice*, SERP'12, 2012, pp. 293–299.

[11] S. M. Davis, *Future Perfect*. Addison-Wesley, 1987.

[12] B. I. Pine, "Mass customization: The new frontier in business competition," 1993, Harvard University Press.

[13] P. Kotler and G. Armstrong, *Principles of Marketing*. Pearson Education, 2009.

[14] P. F. Drucker, *The Practice of Management*. HarperBusiness, 2006.

[15] H.-B. Kittlaus and P. N. Clough, *Software Product Management and Pricing*. Springer Verlag, 2009.

[16] M. Dorfman and R. H. Thayer, Eds., *Software Engineering*. IEEE Computer Society Press, 1997.

[17] F. P. Brooks, "No silver bullet," *Computer*, vol. 20, no. 4, pp. 10–19, 1987.

[18] E. Consortium, *The Market for Customized Footwear in Europe*, F. T. Piller, Ed., 2002.

[19] C. Kieserling, "Mass customization in the shoe industry," 1999, survey conducted by Selve AG, Munich.

[20] Outsize, *Problems and Needs of Customers when buying Clothes and Shoes*, R. Duwe, Ed., 1998.

[21] F. T. Piller, K. Moeslein, and C. M. Stotko, "Does mass customization pay?" *Production Planning & Control*, vol. 15, no. 4, pp. 435–444, 2004.

[22] C. Berger and F. Piller, "Customers as co-designers," *IEE Manufacturing Engineer*, pp. 42–45, August/September 2003.

[23] C. Huffman and B. Kahn, "Variety for sale: mass customization or mass confusion?" *J. of Retailing*, vol. 74, pp. 491–513, 1998.

[24] W. E. Mackay, "Triggers and barriers to customizing software," in *Proceedings of the SIGCHI Conf. on Human Factors in Computing Systems*, CHI'91, 1991, pp. 153–160.

[25] S. R. Page, T. J. Johnsgard, U. Albert, and C. D. Allen, "User customization of a word processor," in *Proc. of the SIGCHI conf. on Human factors in computing systems*, SIGCHI'96, 1996, pp. 340–346.

[26] L. Findlater and K. Z. Gajos, "Design space and evaluation challenges of adaptive graphical user interfaces," *AI Magazine*, vol. 30, no. 3, pp. 68–73, 2009.

[27] L. Findlater and J. McGrenere, "A comparison of static, adaptive, and adaptable menus," in *Proc. of the SIGCHI conf. on Human factors in computing systems*, SIGCHI'04, 2004, pp. 89–96.

[28] A. Bunt, C. Conati, and J. McGrenere, "What role can adaptive support play in an adaptable system?" in *Proc. of the 9th int. conf. on Intelligent user interfaces*, IUI-CADUI'04, 2004, pp. 117–124.

[29] A.Bunt, C. Conate, and J. McGrenere, "Supporting interface customization using a mixed-initiative approach," in *Proc. of the 12th int. conf. on Intelligent user interfaces*, IUI'07, 2007, pp. 92–101.

[30] J. McGrenere, R. M. Baecker, and K. S. Booth, "An evaluation of a multiple interface design solution for bloated software," in *Proc. of the SIGCHI conf. on Human factors in computing systems*, SIGCHI'02, 2002, pp. 164–170.

[31] K. Z. Gajos, J. O. Wobbrock, and D. S. Weld, "Automatically generating user interfaces adapted to users' motor and vision capabilities," in *Proc. of the 20th annual ACM symposium on User interface software and technology*, UIST'07, 2007, pp. 231–240.

[32] G. Z. Krzysztof, J. Wobbrock, and D. S. Weld, "Improving the performance of motor-impaired users with automatically-generated, ability-based interfaces," in *Proc. of the twenty-sixth annual SIGCHI conf. on Human factors in computing systems*, SIGCHI'08, 2008, pp. 1257–1266.

[33] N. Franke and E. von Hippel, "Satisfying heterogeneous user needs via innovation toolkits: The case of apache security software," *Research Policy*, vol. 32, no. 7, pp. 1199–1215, 2003.

[34] K. Oliver, L. Moeller, and B. Lakenan, "Smart customization: Profitable growth through tailored business streams," *strategy+business*, vol. 34, pp. 34–45, 2004.

[35] N. Schwarz, B. Knuper, J.-J. Hippler, E. Noelle-Neumann, and L. Clark, "Rating scales: Numeric values may chance the meaning of scale labels," *Public Opinion Quarterly*, vol. 55, pp. 570–582, 1991.

[36] K. M. Miller, R. Hofstetter, H. Kromer, and Z. J. Zhang, "How should consumers' willingness to pay be measured? an empirical comparison of state-of-the-art approaches," *J. of Marketing Research*, vol. 48, no. 1, pp. 172–184, Feb. 2011.

[37] F. T. Piller and M. Müller, "A new approach to mass customization," *Int. J. of Computer Integrated Manufacturing*, vol. 17, no. 7, pp. 583–593, 2004.

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