Planned Obsolescence in Portable Computers
- Empirical Research Results -

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Abstract

The goal of the study presented here was to use empirical research to verify and to quantify planned obsolescence effects, and specifically to identify the role of user expectations. The products subject to this study were chosen to be portable devices ("notebooks") such as laptops, notebooks, netbooks, and ultrabooks, which were chosen because they are directly used by consumers in large scale, and exhibit a sufficient technical complexity. The population researched were students of a university in southwestern Germany. For data acquisition, a questionnaire with 29 single questions was drafted and pre-tested in a student environment. It took about 15 minutes for filling in.
Indicators measured covered amongst others the life span expectations of the computer, the life span of the previous (not the actual) computer model used, the time of repairs, the warranty period length, and the reason for replacing the last computer.
The interviewees were selected from the Bachelor and Master students of the university applying three-stage cluster sampling. The questionnaire was handed out to a total of 215 students, with a return rate of 99%. Out of the sample of n=212 students 59% stated that they had owned another notebook model before the actual one. In case they had pre-owned a notebook computer, their reasons for replacing it was a technical fault (49%), the fact that it was outdated (40%), missing compatibility (6%) and to 5% other reasons (n=126).
In the researched population, notebook use phase spans range from 3.3 years to 4.6 years. The arithmetic mean use phase length was found to be 4.0 years. Students which read the directions for use experienced a longer notebook use phase (4.6 years). Those students who undertook maintenance operations on their notebook experienced shorter use phase spans (only 3.7 years). With regard to repairs, mainly battery replacement, display repair and the power supply, software, and keyboard repairs were of major importance. The second use phase year was found to be the most repair-intensive phase of the notebooks, although about 65% of all notebooks worked flawlessly without any repair.
Comparison of expectations and observations of use phase lengths yielded the result that 64% of all notebook users expect a longer use phase than they had actually experienced with their previous product. The difference between expectation and observation is highest with the users of Fujitsu Siemens, Apple, Lenovo and Asus notebooks. Brands with a long use phase length seem to be Medion and possibly Toshiba.
As a result, about two thirds of the notebook users might claim to be subject to planned obsolescence due to a mismatch of expected and delivered use phase length, although from a merely technical point of view a sufficient notebook performance might have been delivered which clearly exceeded the warranty period.

1 Introduction

Obsolescence of electrical and electronical products has become a research topic in recent years [1]. Mainly in its variant "planned obsolescence" it has become common understanding to accept the assumption that products are being built intentionally faulty or below their technical potential regarding durability. Proof for this knowledge is scarce, as most of the information is based on individual observations and anecdotes [2].
Intentionally lowering the life span of products, i. e. "planned obsolescence" is said to be favorable for any producing company, as a short product life span leads to a demand increase by customers and/or users over time. Moreover, product quality and life span are correlated to a certain extent to the production and component costs, and thus the consumers' willingness to pay may indirectly influence product quality as well. One aspect though which little attention was paid to recently, is the role of the user expectations when the discussion on planned obsolescence arises.
From a scientific point of view, the technical life span and the use phase length have to be distinguished: The technical life span covers the period of time in which the product is operational and ready to use (i. e. the time between initial purchase and defect of the product). In contrast, the use phase length is not governed by technology, but by the user deciding to discontinue the products use, which may happen at the end of the technical life span, or at an earlier point in time, while the product may still be operational.
Obsolescence of products is a "natural" effect, although it is observed in a technosphere environment. Degradation of materials or wear due to mechanical stresses or other reasons occur with any product. Both the technical product properties designed and built by the producer and the consumers use patterns are relevant for the technical life span of any product. As a consequence, research on planned obsolescence has to observe both technical aspects of the life span limitation and the users behavior, as obviously any product is designed to be used within defined operational limits such as environmenal conditions (e. g. temperature, humidity), servicing (e. g. cleaning, greasing) or maximum stress levels.

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A systematic of obsolescence was given by Packard [3] as early as the 1960s, identifying the functional, the qualitative and the psychological obsolescence. Functional obsolescence is observed when an operational product becomes obsolete due to technical innovations (such as a typewriter becoming obsolete due to computer use). Qualitative obsolescence is observed when a product failure occurs which renders the product obsolete (such as a light bulb becoming obsolete due to wire fusing). Psychological obsolescence is observed when the user ends the product use due to personal preferences although the product might still be operational.
Thus an effort is undertaken to empirically try to confirm the common understanding that "planned obsolescence of electrical products doubtlessly exists". Hence the goal of the study presented here was to use empirical research to verify and to quantify planned obsolescence effects with portable computers, and especially to research the role of consumer expectations. Portable devices cover laptops, notebooks, netbooks, and ultrabooks, which were all subject of this study. The characteristic elements of these products were integrated display, keyboard, touchpad and battery, and an external power supply.
Portable computers ("Notebooks" in the following) were chosen as research objects as they are used in a business-to-consumer environment and thus may be researched by e. g. interviewing a students' population. Moreover, they are electronical products with a high complexity and comparatively high number of interacting electrical components, which should enable an easy identification of planned obsolescence effects.

2 Methods

The theoretical construct [4] to describe is the planned obsolescence of electrical and electronical products, using mobile computers as an example. The dimensions to be researched cover the consumers' expectations, the actual life span, repairs of the computers, warranty aspects, and actual observations of obsolescence. These dimensions formed the basis for the indicators to be measured, which cover the life span expectations of the computer users, the life span of the last (not the current) computer model used, the time of repairs, the warranty period length, and the reason for discarding the last computer. The core question to be answered was if results can be found which support the hypothesis that planned obsolescence occurs in mobile computers.

2.1 Questionnaire Design

The questionnaire was divided into five sections, covering questions (a) on obsolescence in general, (b) on notebook computers in general, (c) on the present notebook, (d) on the previously used notebook, if any, and (e) on personal data. After a short informative written statement, one easy-to-answer introductory question was asked, with specificity and complexity of the subsequent questions increasing. A second text statement expressing thanks for participation finalized the questionnaire which featured 29 questions in total. A copy of the questionnaire may be obtained from the author. Selected questions are presented in the results section of this paper.
A pretest on this questionnaire was carried out by randomly selecting 15 students both male and female of the university campus, and having them fill in the questionnaire. Besides minor revisions, this text yielded an individual duration of about 15 minutes for filling in the questionnaire.

2.2 Interviewees Selection

The interviewees were selected from the Bachelor and Master students of a university in southwestern Germany, as it can be expected that a high share of this population owns and operates portable computers. Moreover, access to this population was easily available, and a good compliance and high answering rate could be expected. Three-stage cluster sampling was applied, by first randomly choosing six master and eight bachelor programs from of a total of 12 master and 21 bachelor programs from two schools of the university. The second step covered the random selection of semesters, and the third step the selection of specific classes. The lecturers of these classes have been approached upfront, requesting access to the students during their classes for about 15 min to fill in the questionnaires. All lecturers cooperated.
A questionnaire procedure was chosen for data acquisition. The questionnaires were handed over to the interviewees in class. While filling in, a contact person was available in the room to answer questions on the spot. The filled in questionnaires were collected, coded and transferred into an SPSS file, using the IBM SPSS Statistics 21 software. The entire work was carried out in May and June 2015 in German language.

3 Results and Discussion

A total of 215 students answered the questionnaires, with a return rate of 99%, as only three students did not return their questionnaires. As not all questions had been answered in all questionnaires, the n figure might be lower than 212. The share of female students answering was 51% (n=210). To describe the sample in more detail, the students were asked for a self-assessment regarding their social milieu, using the SINUS milieus [5] (Table 1). The students were introduced to the milieu definition by characterization of each milieu with a keyword and a two-line characterization. Moreover, a comprehensive graph was presented along with the question, displaying the milieu allocation in a portfolio of social

stratum (lower/middle/uppler class) versus attitudes towards innovations (tradition/modernization and individualization/reorientation).

Table 1. Students self-assessment on SINUS milieu affiliation
(n=197; Question "Please try to allocate yourself to one of these milieus", after a short milieu explanation)

SINUS milieu affiliation	Students figure (absolute numbers)	Students share (%)
Established	23	11.7
Liberal Intellectuals	31	15.7
Performers	19	9.6
Cosmopolitan Avantgarde	14	7.1
Modern Mainstream	38	19.3
Adaptive Navigators	43	21.8
Social-Ecologicals	8	4.1
Traditionals	6	3.0
Precarious	1	0.5
Hedonists	14	7.1
TOTAL	197	100.0

The arithmetic mean life span of the last notebook computer of female users was 4.2 years, while the male users' computers were used for 4.0 years. This difference was proven to be not significant (due to a biserial correlation test with p of 0.574).
Out of the sample of n=212 students 59% stated that they had owned another notebook model before the current one. In case they had pre-owned a notebook computer, their reasons for replacing it was a technical fault (49%), the fact that it was outdated (40%), missing compatibility (6%) and to 5% other reasons (n=126). The following sub-chapters will present additional selected results.
When being asked "How often do corporations take deliberate steps to move consumers to replace an old device by a new one?", 32% of the interviewees (n=212) expected this to happen "very often", 51% "often", 13% "sometimes", 4% "seldom" and 0,5% "never".

3.1 Notebook Use Patterns

The individual use pattern of the computer use can be derived from Table 2. About one third of all students used their computers for longer than four hours a day.

Table 2. Students laptop computer use pattern
(n=207; Question "How many hours per day is the current device being used?")

Daily Laptop use	<1 h	1-2 h	2-3 h	3-4 h	>4 h
Students share (%)	13	16	22	17	32

Table 3. Relevance of reading the directions for use and use according to specifications for product use phase length
(Cross-classified table using questions on the present notebook "Did you read the directions for use before operating your device?" and "Do you feel you are using the device according to its specifications?" along arithmetic mean use phase length of previous notebook given in brackets)

absolute figures	Using the device according to specifications (in brackets: mean use phase length of previous notebook in years)			
Read directions for use	Yes	No	do not know specifications	TOTAL
Yes	27 (4.6a)	3 (4.2a)	7 (3.8a)	37
No	105 (4.0a)	23 (4.2a)	39 (3.3a)	167
TOTAL	132	26	46	204

Designated use of products is a key requirement for a long product use span. Consequently, the interviewees were asked if they had read the directions for use of their computer. Moreover, in another question they were asked if they thought that they used their computer according to its specifications. The combined results from both questions can be found in Table 3. Moreover, the arithmetic mean values of the use phase span of the last notebook in years of the interviewees are given in brackets. These use phase spans range from 3.3 years to 4.6 years and show clearly a correlation between knowledge and compliance regarding intended notebook use. From all users who feel that they are using the devices according to the specifications, the notebooks of users who read the instructions are experiencing a 0.6 years longer use phase span (4.6 versus 4.0 years).

3.2 Maintenance Activities

The question "Were there maintenance activities carried out during the use phase of the device?" was answered by 86% of the interviewees by "no", a mere 14% answered with yes (n=206). From those who answered yes, the individual actions taken were in absolute figures, as multiple answers to this question were possible, software updates (mentioned 10 times), virus removal (8), fan cleaning (7), working memory extension (4), hard disc drive replacement (3). Graphic board driver update and hard disc drive defragmentation each have only been mentioned once, amounting to a total of 34 maintenance activities in the sample. Regarding the mean use phase length of the previous notebook, surprisingly the computers of those users carrying out maintenance activities on their actual notebook were used only 3.7 years, whereas the computers of those who did not carry out any maintenance reached 4.0 years.

3.3 Warranties

For the previous notebook model, the warranty period duration was asked. The answers ranged between one year (17%), two years (54%) and five years (1%), with 28% of the interviewees stating "unknown" (n=126). Arithmetically a mean warranty period of 1.8 can be calculated, which contrasts clearly to the arithmetic mean of the use phase length of the previous notebook of 4.0 years. As in Germany a two year period of warranty is legally required, this may be taken as a quasi standard value, which may be extended upon the producers or retailers choice, but not cut short. Comparing these warranty period lengths it can be stated that the arithmetic mean value of the use phase length (4.0 years) exceeds the warranty period by far.

3.4 Repairs

Regarding repair frequency, both the values for the actual and the previous notebook are on display in Table 4, along with the repair distribution over time. It was found that 65% of all (previous) notebooks never underwent a repair. Out of those repaired, the highest figure of repairs occurred in the second and third year after purchase. As the rechargeable battery is one of the components highly prone to repair and replacement, its time of replacement was studied. Out of the eleven batteries replaced in the previous notebooks, only one each was replaced in the first, third and fifth year of the use phase, whereas in the second year six and in the fourth year two batteries were replaced. This observation might be motivated by replacement activities triggered by the warranty period of two years nearing its end. The same might be the case for the maximum of 15 single repair activities observed in the second year after purchase of the previous notebook (Table 4 part II).

Table 4. Repair frequencies and time distribution of present and previous notebooks

		present notebook	previous notebook
I-How often was/is the device repaired? (relative figures)		*(n=207)*	*(n=122)*
	Never	78%	65%
	Once	19%	20%
	More than once	3%	15%
II-How many years after purchase are the devices repaired? (absolute figures)			
	< 1a	16	6
	1-2a	8	15
	2-3a	9	11
	3-4a	8	8
	>4a	5	4

Figure 1 gives the results of an open question on the repair actions of the present and the previous notebooks. Regarding the previous notebook whose use span has already ended, the battery replacement ranks first, the display repair second and the power supply, software, and keyboard all rank third in importance.

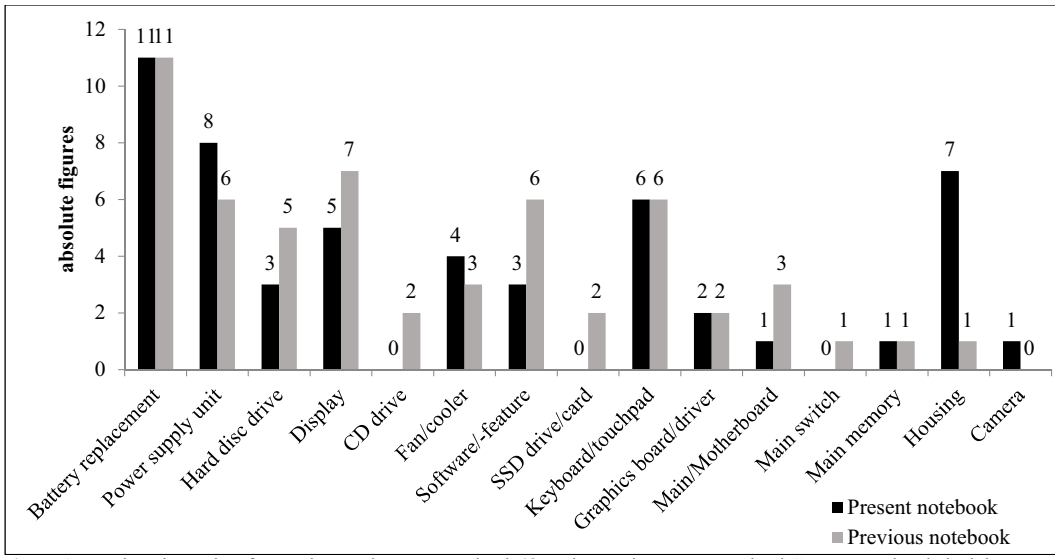

Figure 1. Repair actions taken for previous and present notebook (Question on the present notebook "Have you already had the device or its components (incl. battery, power supply, cord) repaired?" and on the previous notebook "What exactly did you have repaired?")

3.5 Use Phase Length Expectations and Observations

User dissatisfaction may originate from products which offer a service life shorter than expected. Consequently in the study not only the devices' actual use phase length, but also the users' expectations regarding the use phase length have been identified. The arithmetic mean value of expected use phase length of all interviewees including those without previous notebooks was at 5.3 years (n=211), whereas the actual use phase of all previously used notebooks was found to be 4.0 years (n=124). Figure 2 shows the combined data set, with individual expectation-observation data twins plotted in the graph. Out of the total figure of 124 twin data sets, in merely 20 cases (16%) the expectation is identical with the use phase length observation, thus coinciding with the bold black line in Figure 2. In the graph's portion below this line 25 data twins (20%) are allocated, representing users with devices exceeding the users use phase lengths expectation. Consequently, 79 users (64%) have experienced a shorter use phase than expected from their notebook. Regardless of the justification of the expectations, it can be stated that these almost two thirds of the notebook users (64%) form the potential for planned obsolescence arguments.

Eventually from a user and consumer perspective, a brand specific view might be of relevance. To this end, questions on the expected and actual life span of the previous notebook have been combined with the information on the producer of this previous product. The brands covered were HP (n=17), Apple (7), Dell (10), Samsung (16), Lenovo (7), Asus (20), Acer (19), Sony (7), Medion (7), Fujitsu Siemens (5), Toshiba (2) and others (4). As the total figure of datasets of some of the brands is limited, such may be the reliability of these brand specific arithmetic mean values in Figure 3. Nonetheless the comparison of the arithmetic mean value of actual use phase lengths of the individual brands given in grey bars in Figure 3 with the diamond shaped marks for the equivalent expected use phase length reveals that all but one brand fail to meet or to exceed the users expectations. Only in the case of Toshiba is this not the case, but due to only two sets of data for this brand statistical proof is missing. With a mean use phase length of 5.2 years the Medion products are near the arithmetic mean value of expected use phase length of all interviewees, which was found to be 5.3 years. The Fujitsu Siemens users exhibit the highest expectations (6.0 years), and the highest difference of expected and observed use phase (1.7 years), followed by 1.6 years difference values for Apple, Lenovo, and Asus. The lowest differences can be found with 0.3 years for Sony products and 0.2 years for other products.

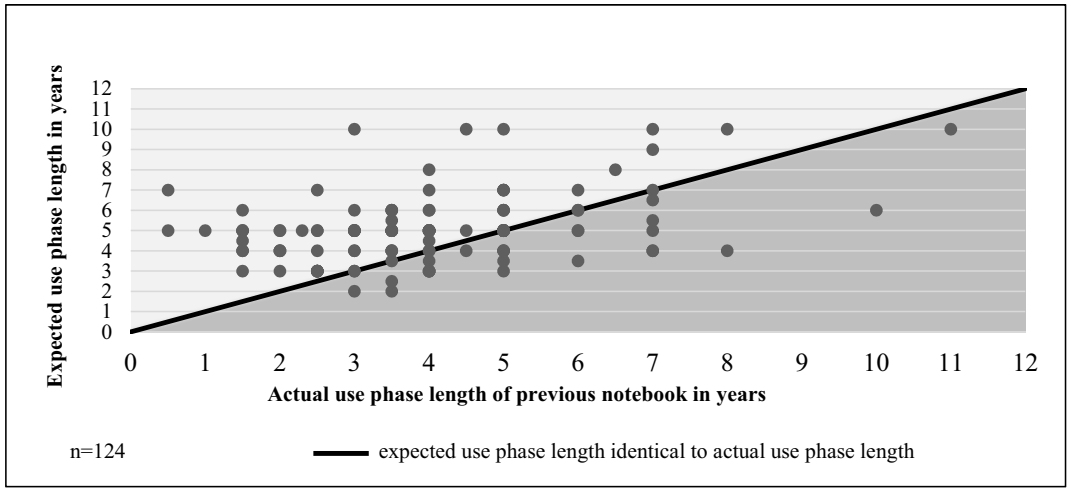

Figure 2. Repair actions taken for previous and present notebook
(Combination of question on notebooks in general "How many years of use phase length do you expect from a notebook?" and on the previous notebook "How many years did you use the device?")

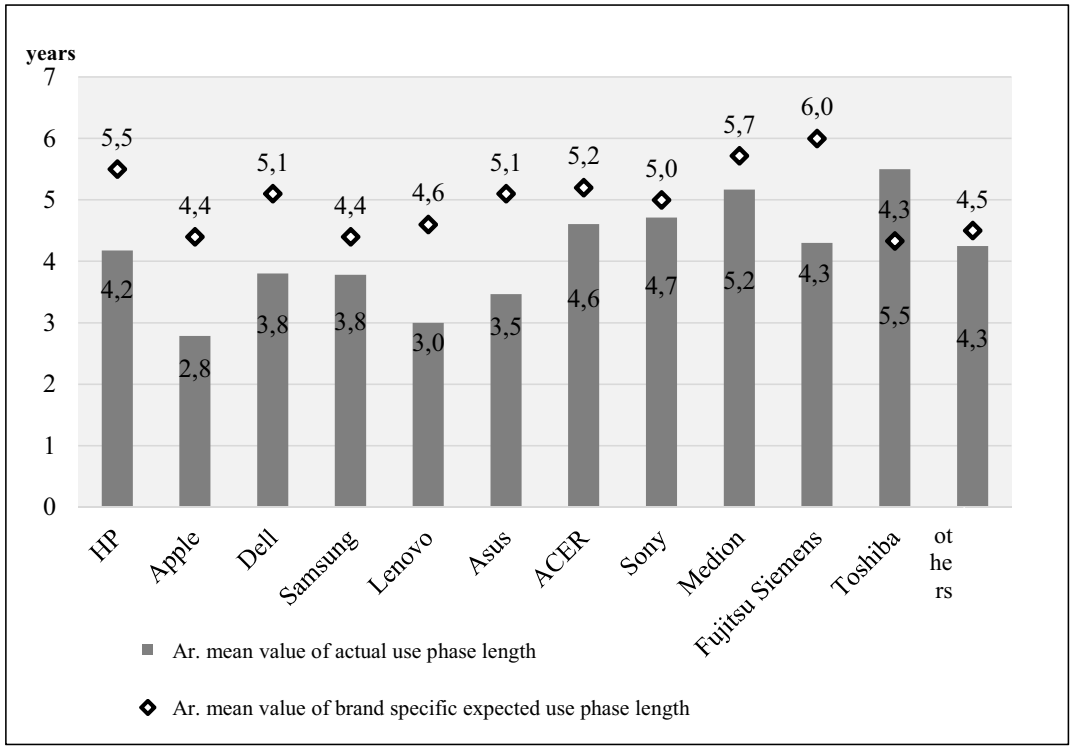

Figure 3. Brand specific use phase length expectations and observations
(Combination of questions on notebooks in general "How many years of use phase length do you expect from a notebook?" and on the previous notebook "How many years did you use the device?" along with "Who was the producer of the previous product?")

4 Conclusions

Although the survey results fail to deliver clear proof of planned obsolescence in the case of notebook computers, some remarkable facts could be extracted from the study:
In a university student environment, notebook use phase spans range from 3.3 years to 4.6 years. The arithmetic mean use phase length was found to be 4.0 years. Students which read the directions for use experienced a longer notebook use phase (4.6 years). Interestingly those students who undertook maintenance operations on their notebook experienced shorter use phase spans (only 3.7 years). With regard to repairs, mainly battery replacement, display repair and the power supply, software, and keyboard repairs were of major importance. The second use phase year seems to be the most repair-intensive phase of the notebooks, although about 65% of all notebooks worked flawlessly without any repair.
Comparison of expectations and observations of use phase lengths yielded the result that 64% of all notebook users expect a longer use phase than they actually have experienced with their previous product. The difference between expectation and observation is highest with the users of Fujitsu Siemens, Apple, Lenovo and Asus notebooks. Brands with a long use phase length seem to be Medion and possibly Toshiba.
As a result, about two thirds of the notebook users might claim to be subject to planned obsolescence due to a mismatch of expected and delivered use phase length, although from a merely technical point of view a sufficient notebook performance might have been delivered which clearly exceeded the warranty period. In fact, the survey showed that more than 80 % of all interviewees expect planned obsolescence to be applied by laptop computer producers often or very often.

5 Zusammenfassung

Das Ziel der hier vorgestellten Untersuchung war es, das Auftreten geplanter Obsoleszenz nachzuweisen und mit Hilfe empirischer Methoden zu quantifizieren, und dabei insbesondere auf die Rolle der Nutzererwartungen einzugehen. Als Untersuchungsgegenstände wurden tragbare Computer („Notebooks“) wie Laptops, Notebooks, Netbooks und Ultrabooks gewählt, da sie von Verbrauchern in großem Umfang direkt genutzt werden und eine hinreichende technische Komplexität aufweisen.
Die untersuchte Grundgesamtheit stellte die Studierendenschaft einer Hochschule in Südwestdeutschland dar. Zur Datenerhebung wurde ein 29 Fragen umfassender Fragebogen erstellt und einem Pretest unterzogen. Das Ausfüllen des Fragebogens benötigte etwa 15 Minuten.
Die so untersuchten Indikatoren umfassten unter anderem die erwartete Lebensdauer des mobilen Computers, die Nutzungsdauer des vorherigen und aktuell genutzten Computermodells, Reparaturzeitpunkte, die Garantiedauer sowie die Gründe für den Austausch des vorherigen Computers.
Die Befragten wurden aus Bachelor- und Masterstudiengängen mit Hilfe einer dreistufigen Klumpenauswahl zufällig ausgewählt. Insgesamt wurde der Fragebogen an 215 Studierende ausgegeben. Die Rückgaberate lag bei 99%. Von den antwortenden Studierenden (n=212) gaben 59% an, sie hätten vor dem jetzigen bereits ein anderes Notebook besessen. Die Gründe für den Austausch des vorherigen Modells waren dessen Defekt (49%), die Einschätzung, das Gerät sei nicht mehr zeitgemäß (40%), dessen fehlende Kompatibilität (6%) und zu 5% andere Gründe (n=126).
In der befragten Gruppe wurden Nutzungsdauern zwischen 3,3 und 4,6 Jahren angetroffen. Das arithmetische Mittel der Nutzungsdauern lag bei 4,0 Jahren. Studierende, die die Gebrauchsanweisung des Gerätes lasen, konnten ihre Geräte länger nutzen (4,6 Jahre). Hingegen lag die Nutzungsdauer der Studierenden, die Wartungsprozesse an ihrem Gerät durchführten, mit 3,7 Jahren deutlich darunter. Die relevantesten Gerätereparaturen sind der Austausch von Batterien, die Reparatur des Displays und von Netzteilen und Software sowie von Tastaturen und Touchpads. Die meisten Reparaturen wurden im zweiten Nutzungsjahr der Geräte durchgeführt. Insgesamt arbeiteten jedoch 65% aller Notebooks störungsfrei ohne jegliche Reparatur.
Der Vergleich der erwarteten und der tatsächlichen Nutzungsdauer zeigte, dass 64% aller Nutzer von Notebooks eine längere Nutzungsdauer erwarten als jene, die von ihrem letzten Gerät tatsächlich erreicht wurde. Die größten zahlenmäßigen Differenzen von erwarteter und erreichter Lebensdauer wurden bei Nutzern der Marken Fujitsu Siemens, Apple, Lenovo und Asus festgestellt. Marken wie Medion und möglicherweise Toshiba scheinen eine vergleichsweise lange Nutzungsdauer aufzuweisen.
Im Ergebnis kann festgestellt werden, dass nach den Befragungsergebnissen etwa zwei Drittel der Notebook-Nutzer die Behauptung aufstellen könnten, von „geplanter Obsoleszenz“ betroffen zu sein, da ihre Erwartungen an die Nutzungsdauer ihres Notebooks nicht erfüllt wurde, obwohl aus technischer Sicht kein Mangel vorliegt, was z. B. anhand einer deutlichen Überschreitung des Garantiezeitraums deutlich wird.

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