Małgorzata LOTKO, Aleksander LOTKO, Radosław LUFT
University of Technology and Humanities, Faculty of Economics and Law, Chair of Commodity Science and Quality Sciences, Radom, Poland
m.lotko@uthrad.pl; aleksandra.lotko@uthrad.pl; r.luft@uthrad.pl

FACTORS SHAPING THE QUALITY OF LAPTOP COMPUTERS IN CONSUMERS' OPINION

Key words

Laptop computer, quality, factor analysis, consumer's opinion.

Abstract

The aim of this thesis was to identify factors shaping consumers' opinions on the quality of laptop computers. Empirical research was carried out with the use of a questionnaire method. The sample size amounted to 110 persons. Statistical analysis was made using one of the multidimensional exploratory techniques, i.e. factor analysis. The obtained model contains 11 out of 15 observable variables, originally identified based on literature studies. Three factors were identified: usability, ecological-marketing, and maintenance-sales. Together they explain 58.96% of the total data variance. All of the measure scales proved to be reliable. The authors managed to considerably confirm J. Żuchowski model of products' utilitarian features. However, the obtained solution turned out to be quite hard in terms of semantic interpretation. A theoretical implication is a formal identification of factors shaping the quality of laptop computers in customers' opinions. A practical implication for producers and marketers can make use of obtained results in business practice to improve the quality of laptop computers. The article's novelty and the authors'

contribution is the use of factor analysis in the researched area and proposing an innovative classification of variables.

Introduction

A computer is the most fundamental medium of processing information and communication in the information society. It is an electronic device designed to acquire information presented in a digital form controlled by a program saved in the memory. Without a computer, it is hard to imagine processing, storing, sending, and using informational resources in an organization. The development of a high quality industry resulted in the production of a computer that may be smaller than is an A4 binder. A mobility trend has been visible in the market of information technology products for more than ten years now. The above-mentioned mobility constitutes a reflection of the contemporary changes in the lifestyle and manner of work splitting the human existence from a particular point in the space, which has been established for a long time. A laptop, being a portable device, has a very wide application. It may be used both as a tool for acquiring and processing data (in industry, science, commerce, services) and a tool used in entertainment (games, watching movies, listening to the music).

Currently, more than ten brands of laptops in various price ranges are available in the market. Such diversity and the constantly growing number of sold computers became a trigger for the research, the object of which was the factors considered by the consumers when evaluating the quality of computers of a considered type.

The aim of the thesis was to identify the factors shaping the evaluation of the laptop computers quality. The aim was reached with the use of one of the multidimensional exploratory techniques, i.e. a factor analysis.

1. Products' quality features

Quality is one of the most important aspects of the competitiveness of modern enterprises. It may concern both the products and services and, for example, resources or management systems. Quality is defined in various ways depending on the view of defining entity and situation. Modern quality management theory is dominated by the compromise approach, which concerns considering it in technical categories and at the same time in economic categories. As far as this approach is concerned, the quality is not merely a set of physical features and characteristic of a particular product or service and distinguishing them from the others, but it is also the ability to satisfy specific needs of consumers. In the contemporary world whose central element is a consumer, his/her satisfaction and expectations become the basic premises for the provision and constant improvement of quality.

Despite of considerable diversity of definitions and views concerning quality, the literature analysis of the object indicates one more common idea, i.e. the satisfaction of the customers' expectations. This trend includes a number of definitions according to which quality is defined as follows:

- The ability to be used, customer's satisfaction [9];
- A predictable degree of uniformity and reliability at the lowest possible costs and adjustment to the customers' requirements [3];
- Compatibility with requirements [2];
- The dynamic condition connected with the products, services, people, processes and environment which either meets or exceeds customer's expectations [8];
- The satisfaction of customers' requirements [17];
- The sum of the characteristics of a product or service in the marketing, designing, manufacturing and service area, thanks to which products and services meet customer's expectations [5]; and,
- The degree in which the set of inherent features meets the requirements [18].

In order to quantify the quality of the products, the evaluation of quality characteristics determining their essence is carried out [23]. A characteristic is every measurable and describable element specifying a given object. A characteristic may be researched by way of various methods, enabling the recognition of a particular set of its various states. A characteristic distinguishing a product is its feature [19].

The quality of goods is defined as a set of those characteristics that determine the usability fitness of goods according to their purpose. Usability is characterized by a set of characteristics important in particular conditions. This set includes the following [20]:

- Technical characteristics – parameters of the construction and technology of a product determining its intended functions;
- Functional characteristics – characterize functionality, convenience and safety of the use and product's reliability;
- Economic characteristics – the cost of the purchase and exploitation of a product and benefits resulting from the possession of a given product; and,
- Aesthetic characteristics – external appearance and diligence of product finish.

Quality technical definitions are connected with the characteristics of quality. The above-mentioned characteristics are quite numerous, and they may be grouped according to a number of various criteria. For example, Ł. Karpiel and M. Skrzypek [11] apart from technical, functional, economic, and aesthetic characteristics, distinguish the following:

- Ergonomic characteristics – characterize the degree of product adjustment to the anatomic, physiologic and psychological characteristics of the users;
- Ecological characteristics – specify mutual relations of the product and natural environment with consideration of raw materials and energy as well as troublesome waste, sewage, and harmful gases; and,
- Logistic characteristics – condition the optimum flow of raw materials, material goods, and information connected with them.

In the contemporary economic conditions, the quality of the goods, apart from the characteristics mentioned above, also depends on the fast growing requirements and expectations of the recipients or users.

2. Quality characteristics of laptop computers

A laptop is a personal portable device acting as a computer, usually quite small. Its name derives from the word lap, i.e. – lap of the knee, as it was intended for work on the laps [4]. The construction of a laptop covers the set of little internal components, which include motherboard, processor, RAM memory, integrated or dedicated graphic card, and basic joints and inputs. Currently manufactured laptops are equipped with panoramic screens (with proportions 16:9). The majority of laptops have diagonal 15.6" screens (1366 × 768 px) and 17.3" (1600 × 900 px or 1920 × 1080 px – full HD).

Portable computers have internal built-in lithium-ion batteries, which allow for a couple of hours of work without the need to use the power-line. External feeders allow for the work and charging of the batteries from the electricity grid. An obvious advantage of laptops equipped with numerous modern technologies allowing for communication with among other the Internet and external devices by way of wireless technology, is a high mobility that is an alternative to big stationary computers. Except for the advantages, we should also mention disadvantages, which cover the limited time of work using the battery, a less ergonomic keyboard, the difficulty of controlling the cursor, and the increase in weight together with the increase in functionalities. What is more, development of a laptop is quite complicated, and laptops practically do not undergo modernization except for extensions intended to be carried out on a standard basis.

As mentioned above, a laptop has become a working tool in the informational society. A fundamental need of a computer user is acquiring, processing, and using information for a specific purpose. When adapting J. Żuchowski [23] model of functional characteristics of products, we may claim that the following factors determine the functional value as the ability to satisfy the needs as follows:

- Reliability, i.e. possibility of effective use in specific conditions and time: The laptop user is, in this case, limited by the circumstances of its

use (a computer cannot be used in extreme atmospheric conditions, for example, outside when it is raining or when the temperature is very low, and the other limiting factor may be the working time of the battery without the need of charging).

- Functionality – when a product satisfies the requirement of practical usability: In the case of a laptop, this characteristic is particularly visible due to the possibility of moving the device from one place to another (with a properly working battery) without the network source of power.
- Durability is the time of the use of a computer without the need of repairing its basic components. It is very difficult to specify the trouble-free time of computer usage, because it is the resultant of a number of factors (for example daily use, force put into the use, materials of which a computer was made, etc.).
- Dexterity as a relation between the functional work and total work put into product exploitation. For example, the time of the use of a laptop without the necessity of direct charging from the electric socket.
- Viability is the time of the use of a product until the moment total wear and tear makes it unusable, for example, the physical wear and tear of the components of casing, keyboard, matrix, and electronic components.
- Repairability – the possibility of repair and maintenance: Computers being the result of the development of high-tech industry are being constantly improved, and, as a consequence, their parameters and technical possibilities become even better. This process has both advantages and disadvantages in terms of the user, because laptops become old quite fast.
- Modernity is the compliance with the requirements of science and technique, in case of a laptop, we are not talking only about its technical parameters but also about aesthetic and ergonomic ones (for example, various sizes of the screen, lower weight, and thickness (ultrabooks) or 360º solutions, where the user can freely adjust the position of the screen towards of the keyboard).
- Safety – the degree in which a product is not dangerous for health or the life of the user: A laptop as a unit charged by electricity should comply with the requirements of the CE European safety certificate.

A decision concerning the purchase of a laptop often depends on the price, the form of presentation in the sales process, and warranty conditions.

When characterising the quality characteristics of a laptop, the ecological aspects should also be taken into consideration. In this case, we are talking about the possibility of utilization or component recycling, participation in the creation of “electrolitter”, as well as the lower price of the components and short-term use. We should also emphasise the outstanding fact of the existence of computers’ secondary market (for example, the sale of post-leasing units) and opening of outlets where you can buy older models at much lower price.

The other characteristics, probably less significant ones from the technical or ecological point of view, are the aesthetic values and diligence of performance. Manufacturers compete with each other and attract consumers with new materials (aluminium casings in various colours and textures), streamlined casings, or unlimited screen rotation. As we mentioned above, computers are aging very fast, thus the increase in their sale is a constant process.

3. Presentation of research methodology

At first we carried out the operationalization of notions within the scope of the quality attributes of laptop computers. On the basis of the analysis of published studies within the scope of product quality issues presented above (among others: [7; 11; 12; 13; 16; 19; 22; 23]) within the scope of product quality, we selected 15 observable variables. They were numbered in the following way: 1 – reliability, 2 – functionality, 3 – durability, 4 – efficiency, 5 – liveliness, 6 – repairability, 7 – modernity, innovativeness, 8 – safety, 9 – aesthetics, trends 10 – presentation (form of offer, sale and post-sale service), 11 – ecology, 12 – diligence of performance, 13 – warranty conditions, 14 – price and 15 – brand image and supplier's reputation.

Values of the variables, i.e. the evaluation of the level of quality measured on a five point scales of semantic balance gear, where 1 stands for "very poor" and 5 for "very good."

Research was carried out with the use of the questionnaire method. The same method was applied for the collection of statistical material. The research was conducted based on a sample of 110 customers of computer stores in the city of Radom from 15th to 30th October 2015.

Factor analysis, which is one of the statistical multidimensional exploratory methods, was applied in the construction of the model. Factor analysis was established and developed mainly in Anglo Saxon psychology. C. Spearman described it in 1904 for the first time. However, the theoretical basics and possibilities of practical solutions were elaborated by L. Thursone. D. Lawley, and A. Maxwell [14] formulated factor analysis as a formal statistical model. It is composed of a set of methods and statistical procedures that allow one to reduce a large number of researched variables to a smaller number of mutually independent (not correlated) factors. Distinguished factors, in assumption, reach back to a much deeper level of researched reality (for example, to the attitudes, values) and constitute the causes laying at the basics of observable variables. At present, factor methods have gained great popularity [21; 6]. In this article, we applied the main component method, which is a typical method used for the classification of variables.

Microsoft Excel 2007 and Statistica 8.0 were applied to develop the above data.

4. Analysis and discussion on the research results

As it was mentioned earlier, factor analysis was applied, i.e. the analysis of the main components (Principal Component Analysis). Figure 1 presents the chart of "factorial scree" according to the Cattell criterion [1].

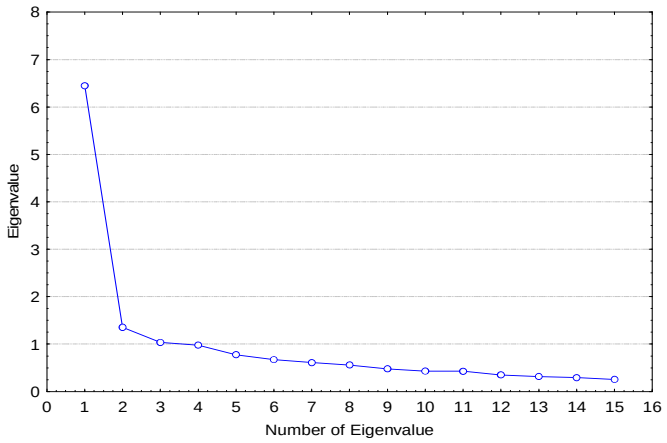

Fig. 1. Factorial scree – Eigenvalues of separated factors

Source: Authors.

Pursuant to the R. Cattell criterion, such a number of factors should be assumed for which the "slope" of the scree begins to flatten. Figure 1 presents that there are four factors in the discussed example. The Eigenvalue of the subsequent selected factors is relatively small; therefore, they do not include much information and should be rejected. On the other hand, Table 1 includes Eigenvalues of factors and the percentage of general variances explained by them.

Table 1. Eigenvalues of factors and the explained percentage of variance

Factor no.	Eigenvalue	% explained variance	Cumulated Eigenvalue	Cumulated %
1	6.450384	43.00256	6.450384	43.00256
2	1.357244	9.04830	7.807629	52.05086
3	1.036104	6.90736	8.843733	58.95822

Source: Authors.

The Eigenvalue indicates which part of the entire variability is 'translated' by a given factor. Pursuant to the Kaiser criterion [10], factors of Eigenvalues

exceeding 1 should be maintained in the analysis. Bearing in mind two of the above-mentioned criteria, a solution with three factors was chosen as the correct one, while the Eigenvalues of the last factor are slightly higher than the value recommended by Kaiser's criterion (1.03 against 1); therefore, we may probably resign from it in the explanation of the structure of the examined construct. Three identified factors jointly explain 58.96% of the total observed variance.

Table 2 presents factor loadings for the combination variable-factor. They are interpreted as correlations between the factors and variables.

Table 2. Factor loadings for combination factor-variable (values > 0.6 were distinguished)

Variable no.	Eigenvalue		
	Factor 1	Factor 2	Factor 3
1	**0.750283**	0.117462	0.247832
2	**0.785898**	0.283259	0.119128
3	**0.754827**	0.092285	0.178339
4	**0.674963**	0.209129	0.281892
5	0.592116	0.263068	0.377837
6	0.343140	0.189323	**0.686600**
7	0.349169	0.537262	0.273130
8	0.286457	0.167262	**0.743255**
9	0.384674	0.426391	0.224052
10	0.142333	0.241291	**0.761237**
11	0.035544	**0.763672**	0.259822
12	0.363186	0.521101	0.480053
13	0.222060	**0.634387**	0.252921
14	0.047900	**0.680157**	0.149730
15	0.382767	**0.699510**	-0.082290

Source: Authors.

Values of factor loadings for all combinations of factors are also presented in Figure 2 (numbers of variables are preceded by prefix "Z").

Based on Tables 1 and 2, the following three-factorial solution was adopted:

– Factor 1 is loaded by 4 variables with number: 1, 2, 3, and 4, i.e. reliability, functionality, durability, and dexterity. It is called utility factor as this factor groups 4 from among 8 variables from the visionary model of characteristics of utility products J. Żuchowski [23]. This factor has the Eigenvalue equal to 6.45 and it explains as much as 43% of the total variance.

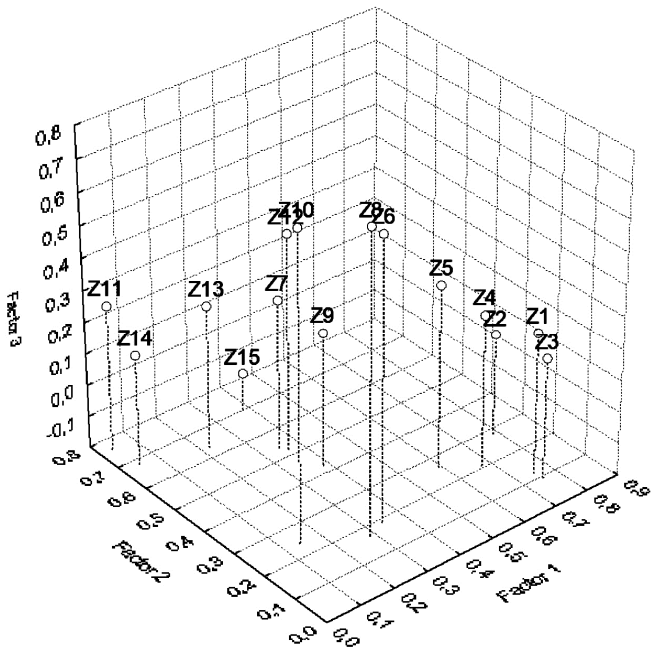

Fig. 2. Values of the factor loadings in three-dimensional space for all combinations of factors

Source: Authors.

- Factor 2 is loaded by 4 variables with number: 11, 13, 14, and 15, i.e. ecology, warranty conditions, price, and brand image and supplier's reputation. This being the case, it was called an ecological-marketing factor. The discovered factor has the Eigenvalue equal to 1.36 and explains 9.05% of the total variance.
- Factor 3 is loaded by 3 variables with number: 6, 8, and 10, i.e. repairability, safety, and presentation (form of offer, purchase, and post-sale service). This being the case, it was called maintenance-sales factor. This factor has the Eigenvalue equal to 1.04 and explains 6.91% of the total variance.

The reliability of the obtained measuring scales was re-examined with the use of Cronbach α measure. A value of 0.82 was obtained for the utility factor, 0.74 for the ecological-marketing factor, whereas the Cronbach α values for the maintenance-sales factor amounted to 0.75. It shows that all the subscales built for measuring factors are reliable.

The analysis of variables forming particular factors shows that, except for the first factor, they group variables of rather different meaning, i.e. they are less coherent in respect of semantics. Thus, the obtained solution is rather quite difficult to interpret.

Conclusions

1. From among 15 variables identified based on literature analysis within the scope of the quality of products, 11 variables are included in the model built with the use of factor analysis.
2. Three factors shaping the quality of laptop computers from the point of view of the customers were discovered:
   – Factor 1 is loaded by 4 variables: reliability, functionality, durability, and dexterity. It is called the utility.
   – Factor 2 is loaded by 4 variables: ecology, warranty conditions, price, and brand image and supplier's reputation. Thus, it is called ecological-marketing factor.
   – Factor 3 is loaded by 3 variables: repairability, safety, and presentation (form of offer, sale, and post-sales service). Thus, it is called maintenance-sales factor.
3. In total discovered factors explain 58.96% of the total data variance.
4. All subscales describing particular factors are reliable.
5. Identified factors, except for the first one, are rather incoherent in the respect of semantics, thus the obtained solution is rather difficult to interpret.
6. Again, the authors [15] greatly succeeded in confirming the accuracy of the model of utility characteristics of products proposed by J. Żuchowski.

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Czynniki kształtujące konsumencką ocenę jakości komputerów laptop

Słowa kluczowe

Komputer laptop, jakość, analiza czynnikowa, ocena konsumencka.

Streszczenie

Celem opracowania była identyfikacja czynników kształtujących konsumencką ocenę jakości komputerów laptop. Badanie empiryczne przeprowadzono metodą ankietową na próbie o liczności 110 osób. Statystyczne opracowanie wyników przeprowadzono, wykorzystując jedną z wielowymiarowych technik eksploracyjnych – analizę czynnikową. W skład uzyskanego modelu weszło 11 spośród 15 zidentyfikowanych na podstawie studiów literaturowych zmiennych obserwowalnych. Zidentyfikowano 3 czynniki: użyteczność, ekologiczno-marketingowy i eksploatacyjno-sprzedażowy. Łącznie wyjaśniają one 58,96% całkowitej zmienności danych. Wszystkie skale

pomiarowe okazały się rzetelne. Udało się w dużym stopniu potwierdzić trafność modelu cech użytkowych wyrobów J. Żuchowskiego. Uzyskane rozwiązanie okazało się jednak dość trudne do interpretacji semantycznej. Implikacją teoretyczną jest formalna identyfikacja czynników kształtujących jakość komputerów laptop w opinii konsumentów. Implikacją praktyczną dla producentów i marketingowców może być wykorzystanie uzyskanych rezultatów w praktyce biznesowej do doskonalenia jakości komputerów laptop. Elementem nowości i wkładem autorów jest zastosowanie analizy czynnikowej w analizowanym obszarze i zaproponowanie innowacyjnej klasyfikacji zmiennych.