Research and assessment of competitive capability of ecologically safe products in the conditions of digital economy

Olga Yarosh 1, Ella Mitina 1*, Natalia Kalkova 1 and Nikolay Klevets 1

1 Crimean Federal University named after V.I. Vernadsky, Vernadskogo av., 4
Simferopol, 295007, Republic of Crimea

* E-mail: zhilina_ella@list.ru

Abstract. Development of the market of organic products over the Internet requires a complex study of the competitive capability of ecologically safe products sold in the conditions of forming the digital economy. In this work we studied regular customers of 54 internet-shops selling organic products. The initial data was obtained through questioning internet-shops customers, with the coverage of 470 respondents. The results were processed with the use of economic-mathematical and statistical analysis methods in the SPSS environment. During the research, we carried out a segmentation monitoring, defined social-demographic criteria to group the sampling survey, then we carried out a factor-related analysis and estimated nine prevailing factors influencing the choice made by the customer as he/she buys ecologically safe products over the Internet. The most relevant factors for customers are: the price, the markings and the shelf life. The integral coefficient of competitive capability with consideration of all the factors is equal to 6.5 in the Harrington’s scale, which means a high level of competitive capability of ecologically safe products in the conditions of forming the digital economy. The main problem is confirmation of compliance of this kind of products by applying the corresponding cryptographic marking.

1. Introduction

Wide scale promotion of organic products over the Internet requires a complex study of the opportunities in the conditions of forming the digital economy to promote absolutely unique commodities with the quality characteristics regulated by international standards and requirements to organic substances [1]. Assessment of the competitive capability of such products is not easy, so it is reasonable to carry out the analysis of the competitive capability of the ecologically safe products themselves that are sold by internet-shops, from the viewpoint of customers’ opinions, which conditions the importance and timeliness of this research. Foreign researchers studying the organic products markets [2, 3] choose the customers’ opinions as the object of research and analysis; on the other hand, Russian researchers [4] focus on the products themselves to assess their quality and competitive capability. Due to this, within the framework of this research, we attempted to consolidate the Russian experience of using the assessment methods and coordinate it with the possibilities to promote such products in the conditions of forming the digital economy, with the use of the research algorithms that are applied by foreign scholars studying the potential of organic products.

The purpose of this research is assessment of the competitive capability of ecologically safe products sold through internet-shops.
2. Methods of research
The initial data was obtained as a result of the marketing research carried out over the Internet. The data was processed with the help of economic-mathematical and statistical analysis method in the SPSS environment; we carried out a factor-related analysis to find the basic factors influencing the choice made by the customer as he/she buys ecologically safe products in the conditions of digital economy.

3. Results
In order to identify the factors related to the values and priorities of the customers as they select the commodities to buy, we carried out a marketing research in the Internet using a questionnaire. As a result, we questioned 470 respondents – regular customers of internet-shops who have a well-established opinion based on their own experience and knowledge of the customer properties of commodities, including the ecologically safe ones; in our opinion, these customers are experts in buying commodities for their households [5].

In our research, all the respondents were divided into target groups by the following characteristics: “sex”, “age”, “marital status” and “with/without children”. The first group included 180 men, and the second group included 290 women.

By their age, respondents were divided into four groups: “under 21”, “21–45”, “45–65”, “over 65”. The group “under 21” included 70 respondents, 210 people belonged to the category “21–45 years old”, the group “45–65” had 130 experts, and the group “over 65” had 60 people.

By the characteristic “marital status” two groups were formed: “married” and “not married”, which included 270 and 200 respondents, respectively.

By the characteristic “with/without children”, two groups were formed: “with children” and “without children”. 200 respondents were in the group “with children”, and 170 respondents were in the group “without children”.

Dividing the respondents into target groups makes it possible to carry out a focused communicational, commodity-related and strategic policy with consideration of particular features of the formed target groups.

During the next stage, we assigned points to assess the most relevant factors for customers as they choose particular ecologically safe products. In order to assess the degree of satisfaction of end users of the ecologically safe products, it is necessary to develop criteria for assigning points to assess every factor. Criteria for assessment of selected particular factors can be determined by the closeness of values of customer characteristics to the highest level and carry out assessment by the points with a scale from 1 to 10. If a factor has 1–3 points, the level of the end-customer satisfaction is the lowest; with 4–7 points it is medium, and with 8–10 points it is the highest, i.e. the closer the characteristic is to the value of 10, the higher is the influence of this parameter to the customer’s choice.

After that, we assessed the coherence of experts’ opinions on the basis of the results of assessing the number of points. In order to do that, we calculated the cosines of angles between the vectors of the assessed parameters for each pair of experts by the equation [6]:

\[ c_{ij} = \frac{n \sum_{n=1}^{N} P_i^n \cdot P_j^n}{\left( \sum_{n=1}^{N} (P_i^n)^2 \right)^{\frac{1}{2}} \cdot \left( \sum_{n=1}^{N} (P_j^n)^2 \right)^{\frac{1}{2}}}, \]  

(1)

where, \( c_{ij} \) is the coefficient of coherence of experts’ opinions (cosine of the angle between the vectors of the assessed factors of experts number \( i \) and \( j \) in the target group),

\( N \) is the number of factors (in this case, \( N = 9 \)),

\( i, j \) are the numbers of experts,

\( P_n \) is the assessment of the factor number \( n \).
Our calculations showed that the coefficient of coherence between opinions amongst men is 0.67 and amongst women it is 0.69. It should be noted that the calculated coefficients of coherence for other groups of respondents have the values above 0.6 which means quite a high coherence of experts’ opinions.

Then it is necessary to determine the correlation between the factors selected by the respondents in order to estimate the dependence between them, with the use of the software pack SPSS. As a result of the calculation, we estimated that the coefficient of the pair correlation between the factors is below 0.7 in each target group, which indicates the relevancy of all the factors for the customer as he/she chooses a particular ecologically safe product. The results of the correlation dependence are presented in the Appendix.

After that it is necessary to calculate the averaged relevancy of factors for the respondents in target groups. Table 1 shows the mean arithmetic values of the importance of factors by groups of customers.

**Table 1.** Averaged assessment of factors by groups of customers (compiled by the authors from the results of questioning of the respondents).

| item | Factor | Groups of customers | | | | |
|------|--------|---------------------|---|---|---|---|
|      |        | sex | age | marital status | with/without children | |
|      |        | m   | f   | < 21 | 21-45 | 45-65 | > 65 | married | not married | with children | without children |
| 1    | Price  | 9.3 | 8.4 | 9.1 | 8.8 | 8.2 | 9.8 | 8.7 | 8.9 | 9.2 | 8.4 |
| 2    | Availability of information | 4.7 | 4.9 | 4.3 | 6.4 | 4.8 | 5.3 | 4.6 | 5.2 | 4.9 | 4.9 |
| 3    | Recommendations | 5.7 | 5.4 | 4.0 | 4.9 | 5.2 | 6.8 | 6.3 | 4.7 | 6.1 | 4.5 |
| 4    | Composition | 5.1 | 7.5 | 7.4 | 6.0 | 5.4 | 7.8 | 6.3 | 7.2 | 6.8 | 6.8 |
| 5    | Wide range of products | 4.8 | 5.6 | 5.6 | 6.9 | 5.9 | 5.3 | 5.1 | 5.5 | 5.2 | 5.0 |
| 6    | Shelf life termination date | 5.9 | 5.8 | 6.0 | 4.7 | 5.5 | 6.3 | 5.7 | 6.0 | 6.1 | 5.4 |
| 7    | Popularity of the brand | 5.4 | 4.7 | 5.4 | 5.8 | 4.2 | 3.5 | 5.3 | 4.6 | 4.8 | 5.3 |
| 8    | Innovative character | 2.6 | 2.3 | 3.1 | 2.1 | 2.5 | 1.3 | 2.0 | 3.0 | 1.6 | 3.7 |
| 9    | Prestige value | 4.0 | 3.3 | 3.4 | 3.8 | 4.0 | 2.0 | 3.7 | 3.4 | 3.1 | 4.1 |

Table 1 shows that, for the male respondents, the most relevant factors are: price, shelf life termination date and recommendations, because men, due to their psychology tend to trust other people’s opinions, which explains the fact that the users’ content is way more effective than advertising.

It should be noted that the female respondents considered the following factors as the most relevant: price, shelf life termination date and the composition (ingredients) of the product, as the female target group buys goods for their entire families, so they thoroughly examine the composition and worry about the health of their next of kin.

As we examine the respondents with consideration of their age, the following factors are the most relative for different age groups:

– for the group “under 21”, the most relevant factors are: price, composition and shelf life termination date, because this target group was mainly consisted of schools and colleges who took independent decisions about the purchase, who said that there had been numerous cases of poisoning with food, and the requirements for availability and veracity of information about the shelf life termination dates;
– for the group “21–45”, the most relevant factors are: price, wide range of products, availability of information, this category includes young parents and women with babies, who want to avoid buying surrogate products or the food containing additives and conserving agents;
– for the group “45–65”, the most relevant factors are: price, wide range of products, shelf life termination date, because people of this group like to select from a wide range of commodities to satisfy their actual needs in the most efficient and inexpensive way;
– for the group “over 65”, the most relevant factors are: price, composition, recommendations, as the people in this group, due to their age, are somewhat suspicious, but, nevertheless, they do listen to other customers’ opinions.
Assessing the results of questioning the respondents who have children, we can notice somewhat stricter requirements to ecological safety of the products as compared to the respondents who have no children, because this target group, besides the factors like: price, composition and shelf life termination date, highlighted the necessity to consider the recommendations of others, including those of the experts in the relevant sphere.
Respondent, irrespective of their marital status, selected the same relevant factors, which means that “marital status” can be ignored while promoting a commodity in the market.
It should be noted that, despite the different numbers of points assigned during the relevancy assessment in all the groups of customers, the most relevant factor is the price, and the least relevant one for all the groups of customers in regard of the ecologically safe products is the “innovative character”.
During the next stage, we normalized the weighted coefficients of factors regarding the value of one [7] by the equation:

$$W_i = \frac{w_i}{W_k},$$  \hspace{1cm} (2)

where, $W_i$ is the normalized weighted coefficient of the factor,
$N$ is the number of factors (N=9),
$w_i$ is the corresponding value from table 1 before normalizing,
$W_k$ is the sum of not normalized weighted coefficients of the considered factors.
Table 2 shows the weighted coefficients of factors by the groups of customers normalized by the value of one.
Table 2. Weighted coefficients of factors by the clusters of customers normalized by the value of one.

| Item | Factor                  | Clusters          | Sex | Age | Marital status | With/without children |
|------|-------------------------|-------------------|-----|-----|----------------|-----------------------|
|      |                         |                   | m   | f   | < 21           | 21-45                 | 45-65 | > 65 | married | not married | with children | without children |
| 1    | Price                   |                   | 0.20| 0.18| 0.19           | 0.18                  | 0.18  | 0.20 | 0.18    | 0.18          | 0.19           | 0.17            |
| 2    | Availability of information |               | 0.10| 0.10| 0.09           | 0.13                  | 0.11  | 0.11 | 0.10    | 0.10          | 0.10           | 0.10            |
| 3    | Recommendations          |                   | 0.12| 0.11| 0.08           | 0.10                  | 0.11  | 0.14 | 0.13    | 0.10          | 0.13           | 0.09            |
| 4    | Composition             |                   | 0.11| 0.16| 0.15           | 0.12                  | 0.12  | 0.16 | 0.13    | 0.15          | 0.14           | 0.14            |
| 5    | Wide range of products  |                   | 0.10| 0.12| 0.12           | 0.14                  | 0.13  | 0.11 | 0.11    | 0.11          | 0.11           | 0.10            |
| 6    | Shelf life termination date |               | 0.12| 0.12| 0.12           | 0.10                  | 0.12  | 0.13 | 0.12    | 0.12          | 0.13           | 0.11            |
| 7    | Popularity of the brand |                   | 0.11| 0.10| 0.11           | 0.12                  | 0.09  | 0.07 | 0.11    | 0.09          | 0.10           | 0.11            |
| 8    | Innovative character    |                   | 0.06| 0.05| 0.6            | 0.4                   | 0.05  | 0.03 | 0.04    | 0.06          | 0.03           | 0.08            |
| 9    | Prestige value          |                   | 0.08| 0.07| 0.7            | 0.8                   | 0.09  | 0.04 | 0.08    | 0.07          | 0.06           | 0.09            |
| 10   | TOTAL                   |                   | 1   | 1   | 1              | 1                     | 1     | 1    | 1       | 1             | 1              | 1               |

Source: compiled by the authors from the results of the points assigned by the respondents.

Then, on the basis of the averaged numbers of points assigned and the relevancy of factors normalized by the value of one, we estimated the generalized value of attractiveness of ecologically safe products by the equation [8] for every target group:

$$P_k = \sum_{i=1}^{9} Q_i \cdot W_i,$$

where, $P_k$ is the generalized value of attractiveness for the target group number $k$ ($k = 1, \ldots, 10$);
$Q_i$ is the averaged assessment of the factor taken from the corresponding column of Table 1;
$W_i$ is the weighted coefficient of the factor number $i$ (table 2).

Table 3 shows the weighted average points of attractiveness of goods for target groups of customers.
### Table 3. Weighted average values by the groups of customers.

| Attractiveness value | Sex | < 21 | 21-45 | 46-65 | > 65 | Married | Not married | With children | Without children |
|----------------------|-----|------|-------|-------|------|---------|-------------|---------------|-----------------|
|                      | m   | 6.8  | 6.1   | 6.8   | 6.5  | 6.7     | 6.7         | 6.5           | 6.2             |
|                      | f   | 6.5  | 6.5   | 6.8   | 6.5  | 6.7     | 6.7         | 6.5           | 6.5             |

It should be noted that weighted average values only help estimate the attractiveness of ecologically safe products. That is why the integrated coefficient of competitive capability can be calculated during the tenth stage as a weighted mean geometric average of the attractiveness coefficients of ecologically safe products with consideration of all the factors by the equation [9]:

$$ICC = \prod_{i=1}^{10} P_i^{s_i},$$

where, $ICC$ is the integrated coefficient of competitive capability; $P_i$ is the generalized value of attractiveness from table 3; $s_i$ is the weighted coefficient of the target group number $i$.

This method was selected because the obtained generalized values differ between the target groups. Weighted coefficients for target groups shall be normalized by the value of one:

$$\sum_{i=1}^{10} S_i = 1$$

As all the target groups are similarly relevant for our research, and the generalized values of attractiveness have the same weighted coefficients $s_i = 0.1$ ($i=1...10$). Later on, the weighted coefficients for target groups can be elaborated with consideration of the volume of particular target groups.

Therefore, integrated coefficients of competitive capability of ecologically safe products will be equal to:

$$ICC = 6.8^{0.1} \cdot 6.5^{0.1} \cdot 6.1^{0.1} \cdot 6.8^{0.1} \cdot 6.5^{0.1} \cdot 6.7^{0.1} \cdot 6.7^{0.1} \cdot 6.5^{0.1} \cdot 6.2^{0.1} \cdot 6.5^{0.1} = 6.5$$

During the final stage, as we interpret the integrated coefficient of competitive capability of ecologically safe products, let us use the Harrington’s scale showed in table 4.

### Table 4. Interpretation of the values of the coefficient of competitive capability of ecologically safe products [10].

| Values of the coefficient of competitive capability | Characteristic of the level of competitive capability |
|---------------------------------------------------|-----------------------------------------------------|
| 8.1 – 10                                           | The highest level of competitive capability          |
| 6.5 – 8.0                                          | High level of competitive capability                |
| 3.8 – 6.4                                          | Medium level of competitive capability              |
| 2.1 – 3.7                                          | Low level of competitive capability                 |
| 0 – 2.0                                            | An absolutely non-competitive commodity             |
4. Conclusion
The integrated coefficient of competitive capability is equal to 6.5, which means a high level of competitive capability of ecologically safe products sold in the conditions of forming the digital economy.

5. Recommendations
In order to maintain a high level of competitive capability of ecologically safe products, it is necessary to take a number of measures:

1. Carry out an efficient advertising campaign to help promote a healthy way of life and spread the information for the customers in internet-sites about the relevancy of commodities of particular kinds, because the customers mainly use recommendations from the people they know as they select which ecologically safe products to buy.

2. Implement a compulsory certification system for ecologically safe products to ensure the high quality of the products [11]. However, it should be noted that this commodity will be sold at a higher price and, as the price is the most important factor for all the customers, it is necessary to indicate the advantages from buying and using the products of the particular kind, which will prevent the customers from buying surrogates, “green washing” items and products with additives and conserving agents.

3. Improving the legal basis by adding the organic products to the list of commodities subject to compulsory identification marking, assigning unique digital codes protected with cryptographic means (two-dimensional code Data Matrix, QR-code), as specified in the Order by the RF government on 28 April, 2018, No.792-p, which will facilitate to decrease the volume of illegal and counterfeit products in the market.

4. Improving the authorities’ support to stimulate the wider offer of ecologically safe products in the market, which will promote a wider range of products to meet the actual demand of customers at a reduced cost.

Complex implementation of these measures will make it possible to improve the quality and length of life and promote forming a steady pace of development of particular regions as a whole.

6. Directions for further research
Studying the issues related to compliance of the products sold through internet-shops with the quality standards and requirement for ecologically safe products, including the ecological marking, forming an integrated information database of manufacturers of organic products as an element of the digital environmentally-aware system, which will make it possible for any participant of the tripartite system “State-Manufacturer-Customer” to monitor the path of organic products from the farm to the retail shop shelf.

Acknowledgements
This work was carried out within the framework of the grant from the Russian Foundation for Basic Research (RFBR) No.17–32–00009-OGN “The Market of Organic Agricultural Products: Promoting and Predicting the Market Situation in the Region”.

References
[1] Mitina E A and Yarosh O B 2017 Economics and Business 8–4 (85) 70–79
[2] Atanasoaie G 2011 Journal of Horticulture, Forestry and Biotechnology 15 (3) 19–25
[3] Connolly C and Klaiber H A 2014 Journal of Agricultural Economics 96 1102–1116
[4] Mitina E A 2017 RISKS: Resources, Information, Logistics, Competition 4 78–84
[5] Mitina E A 2016 Marketing in Russia and Abroad 4 130–134
[6] Oglezneva L A 2012 Qualimetry: a Study Book (Tomsk: Tomsk Polytechnic University Publishers)
[7] Danko T P and Zarova E V 2015 Economic Sciences 126 105–112
[8] Ambler T 2000 Business Strategy Review 11 59–66
[9] Davis J 2007 Measuring Marketing: 103 Key Metrics Every Marketer Needs (Singapore: John Wiley & Sons)
[10] Nasir V A and Karakaya F 2014 Agribusiness 30 290–308
[11] Lukins A V 2014 Economics and Business 6 808–811