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QUALITY AND ITS IMPROVEMENT IN THE CONTEXT OF AGILITY IN POLISH ORGANIC FOOD PROCESSING

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Abstract:
In a world of increasingly advanced technology and market turbulence caused by geopolitical turmoil and the spread of diseases of affluence, there is a growing need to adapt products and services to current market requirements in response to consumer expectations. The need to find its place in a constantly changing further and closer business environment has been also recognized in the agri-food sector. Consumers, looking for alternatives to industrially produced food and wanting to improve their well-being, have in mind, above all, not only the health quality of the food but also the absence of physical and chemical contaminants, and therefore, they are increasingly inclined to purchase organic food products. Under these circumstances, many Polish enterprises that choose this type of production are looking for solutions that allow them to respond quickly to changing consumer expectations. This paper first critically analyzes the scientific literature by compiling publications on aspects of enterprise agility to analyze issues related to quality assurance and its improvement as a manifestation of meeting customer expectations. This allowed for the identification of the research gap and formulation of the research objective, i.e. the assessment of the quality improvement activities as important problems of agility in Polish organic food processing. The main part of the empirical research was conducted in 2021-2022 using a questionnaire dedicated to entities involved in organic food production. The research was comprehensive in nature. The questionnaire was distributed to the entire population surveyed whereas the amount of the results leads to the conclusion that the sample is representative. Statistical analysis and inference were carried out using Kolmogorov-Smirnov, Shapiro-Wilk, ANOVA-Kruskal-Wallis, and U-Mann-Whitney tests.

Key words: *quality, quality improvement, agility, organic food processing*

INTRODUCTORY CONSIDERATIONS FOR AN AGILE AND QUALITY-IMPROVING ORGANIZATION

Armed conflicts and fluctuating prices of raw materials, the aging and increasing diversity of the social structure, and the increasingly adverse consequences of diseases of affluence and fears of potential new pandemics cause the dynamic variability of the closer and further environment of enterprises [1, 2, 3, 4].

As demonstrated by Kriz et al. [5], under these turbulent circumstances, well-functioning organizations are able to respond to challenges from the market by quickly adjusting their services to meet changing customer expectations [6, 7]. As argued by Grant, Rumelt, and Cao [8, pp. 266-267, 9, 10], changing expectations encourage enterprises to constantly look for ways to adapt to the environment and do it better and faster than their competitors. Furthermore, Singh et al. [11] and Kumar et al. 12] found that the key to market success in meeting customer expectations is primarily to improve product quality. As cited in studies by Imai [14], Szczepańska [15], Jacques [16], and Maani et al. [17], the terms "improvement" and "quality" are inextricably linked. Quality cannot be considered without its improvement [18]. The multifaceted nature of approaches to improving product quality in enterprises is inherently linked to the intersecting (intentional or not) activities within a single business entity, as described in many management concepts based on, among other things, TQM, Kaizen, and lean and agile manufacturing [19]. Quality improvement is one of the key focus areas in these concepts. It is perceived as a continuous work on a process that never ends as there are constant transformations in the enterprise resulting in changes in customer preferences [20]. These changes can generate market opportunities, whose emergence, as found by Karpacz [21], can benefit organizations. In the first instance, these will be organizations characterized by agile behavior, for which quality and its improvement are of key importance.

However, it should be noted that despite a large number of publications on the concept of agility in the strict sense, and studies addressing the issues of quality and its improvement, there is a noticeable lack of scientific reports collectively analyzing the issues of agility and improvement as necessary activities to meet customer expectations. Few authors, such as Nafei [22] and Yusuf et al. 3323] have only drawn attention to the problems of quality by showing that agile manufacturing should be viewed as a production system for meeting rapidly changing market needs, where integrating speed, flexibility, innovation, and quality by reconfiguring resources and applying best management practices aimed at delivering customer-focused products and services is crucial. The need for the continuous development of quality in the model-based perception of manufacturing agility was also discussed in research conducted by the Iacocca Institute [24]. Based on the extensive review of agility issues in the context of quality, the study by Vokurk et al. [25] should also be cited. The researchers defined agility as the ability to produce and effectively offer a wide range of high-quality products in a short time so that the enterprise creates value for the customer through customization. The links between the concept of agility and aspects of quality in the context of increased productivity have also been examined by such authors as Swafford et al. [26] or Devadasan et al. [27]. Furthermore, the importance of quality in the problems of agility has been emphasized by Van Hoek et al. [28], Maskell [29], and Hormozi [30], who considered it an opportunity to create an appropriate level of product/service quality that evokes excitement in customers. Such a customer orientation, as emphasized by Gunasekarajan et al. [31] and Yusuf et al. [32], is possible through product improvement and development processes. This opinion is in line with studies by Oyedijo [33] and Vazques-Bustelo et al. [34], who argued that in agile enterprises, improvement work on new technologies is necessary, as is the implementation of innovations in the broadest sense. The need for multifaceted improvement activities has also been noted in the studies by Meredith et al. [35], Maskell [29], Zhang and Sharifi [36], Crocitto et al. [37], and Yusuf et al. [32], who emphasized the role of regular conducting product-related development research, which allows for a quick response to customer requirements, thus staying ahead of the competition. However, as reported by Stachowiak et al. [38], Singh et al. [39], and Vinodh et al. [40], such a response is possible only if the business entity is oriented towards thinking in the long term, directly related to the concept of improvement, which in the practice of business operation is often equated with the principle of continuous improvement. According to Stoner et al. [41], Imai [42], Bessant et al. [43], and Hamrol [44] the principle of continuous improvement implies continuous and at the same time conscious action, based on the continuous implementation of both small changes and spectacular innovation, adapting the organization to market expectations. This means the rational use of management tools and techniques, but also the skillful and optimal choice of technical and technological parameters in the processes of production or providing services. Improvement is the basic idea of many quality-oriented standards, especially important for the entities involved in the food production and distribution chain that need to quickly respond to changing customer preferences. As shown in the study by Han et al. [45], and the WHO report [46], nowadays, buyers are looking for foods that contain the macro- and micronutrients necessary for the proper functioning of the human body and, first and foremost, are safe. Many consumers believe these expectations are met by organic food. Its production, according to the provisions of the legal acts [47], is performed within certified farm management and food processing systems. It combines production practices that are most beneficial for the environment, climate, and human health. It is the organic food's quality characteristics of healthiness, safety[1], sensory appeal, and availability [48] that determine its purchase.

Based on the research, for enterprises that process organic foods, the described concepts related to agility and quality improvement take on particular importance in the search for their management, organizational, or technological solutions that fit in with current food trends. It should be noted that previous studies on organic food processing have focused on the one hand, on its general characterization [49, 50], describing the factors that determine its operation [51], and on the other hand, have referred to the quality of selected groups of organic food [52, 53].

At the same time, a study conducted by Dziuba et al. [54] found that these business entities, by responding to changes in consumers' eating habits and thus following their expectations, show the behavior of an agile organization.

Under these circumstances, it was deemed appropriate to undertake further research in an attempt to identify and indicate the scope of improvement activities that have a decisive impact on product quality being an important element of agility in organic food processing enterprises.

The research also aimed, on the one hand, to determine the differences in the assessment of individual aspects of product quality improvement between two groups of producers (those producing conventional and organic food, and those engaged only in the production of organic food), and on the other hand, to assess whether there is differentiation of these improvement activities in such categorized groups of producers depending on their capital, scope, duration of operation, and size.

METHODOLOGY

To implement the adopted research concept, it was decided that the optimal method to describe the characteristics of quality improvement activities in organic food

[1] In the present study, safety is understood as the health safety of food (no risks to the consumer) achieved using appropriate measures.

processing enterprises that have the characteristics of agile organizations was the questionnaire survey method. For this purpose, a research questionnaire was developed, adapted to the specific conditions of organic food processors in Poland. EU and Polish legislation [55, 47] impose an obligation on such enterprises to both certify such production and report it to a central register. In late 2021 and early 2022, contact information for 566 manufacturers has been obtained from this register for the purposes of this study. Based on these data, an attempt was made to contact all these business entities, making the research an exhaustive study. If the respondent agreed to participate in the survey, the questionnaire, prepared in advance, was filled out by a telemarketer properly trained in conducting research using the CATI method. In-depth studies were agreed to in 259 cases, 58 of which were enterprises producing only organic food, and 201 were taking steps towards organic and conventional production in their business profile.

In the business entities surveyed, the respondents were individuals responsible for the quality-related area. Respondents, when asked a general question about their perceptions of quality improvement activities at their enterprise by indicating detailed responses from Q1 to Q11, which are presented in Table 1, had the opportunity to assess these activities in multiple ways. As part of the survey, respondents provided information on both their perceptions of quality improvement activities on the Likert scale (see Table 1) and by indicating qualitative and ordinal characteristics, such as enterprise size, the origin of capital, and the scope and duration of its operations.

Each option presented in Table 1 was rated on a five-point Likert scale, where -2 meant an “Absolutely no” answer, 0 - “It’s hard to say”, and +2 meant an “Absolutely yes”. The use of the Likert scale allowed the choice of quantitative methods for verifying the dependence and effect of selected characteristics on the assessments made by respondents.

Meeting the objectives of the study required the use of statistical analysis based on parametric and non-parametric tests. First, the Kolmogorov-Smirnov test and the Shapiro-Wilk tests were used. These tests are essential, among other things, in the process of selecting research methods. For the rest of the study, it was decided to use the ANOVA-Kruskal-Wallis test and the U-Mann-Whitney test. The ANOVA-Kruskal-Wallis test was used to verify hypotheses based on more than two groups. In contrast, the U-Mann-Whitney test in the present study was used to divide the sample into two independent parts. These tests are non-parametric tests dedicated to independent samples and refer to the order in the population, whereas the interpretation of the results in this study was based on the evaluation of the median value. During interpreting the data, the median is a value of respondents' ratings that divides the population sample into two equal parts. The study used variants of the tests with continuity correction, assuming *a priori* that assessment distribution can take values from the entire range from -2 to 2 with a neutral point 0 (I don’t know/I have no idea).

Table 1
Summary of specific measures to improve the quality of organic food

In your enterprise, are quality improvement activities in the context of agile behavior connected:
Q5.01. With overall coordination of efforts to improve product quality in all departments of the enterprise
Q5.02. With the use of appropriate methods to improve the quality of products
Q5.03. With the operation of the laboratory
Q5.04. With the improvement of the technological process
Q5.05. With strict adherence to organic food production procedures
Q5.06. With meeting customer expectations
Q5.07. With implemented standards, such as HACCP and ISO 9001.
Q5.08. With the involvement of management-level employees in the implementation of product quality improvement activities
Q5.09. With the involvement of executive-level employees in the work to improve product quality
Q5.10. With the increase of innovative thinking of employees in the context of quality improvement
Q5.11. With the increase in the number of quality-related training courses

Based on the statistical analysis using the aforementioned tests with such a large research sample (259), the estimates obtained lead to general conclusions on the entire population of certified organic food processors. The analyzed group of food processors is not constant: as statistics show, their number is steadily increasing. Therefore, inference based on a sample of 259 is possible using statistical methods that allow their generalization.

Based on the survey results, frequency tables were created to characterize the business entities studied. Graphs showing the distribution of variables were based on contingency tables. The Statistica 13 software was used to analyze the data as a tool for testing the structure coefficient hypothesis (the percentage of enterprises in the population studied should be significantly different from zero), and it was also used to create contingency tables and frequency distributions of characteristics.

RESULTS AND DISCUSSION

The study aim, connected with the determination of the differences in the assessment of individual aspects of product quality improvement between two groups of producers (those producing conventional and organic food, and those engaged only in the production of organic food), and, on the other hand, the attempt to assess whether there is a differentiation of these improvement activities in such categorized groups of producers due to their capital, scope and duration of operation, and size, required a structured grouping of data that was the basis for further analysis.

Therefore, in the first stage of the study, the hypothesis of normality of statistical distributions was verified. The Kolmogorov-Smirnov and Shapiro-Wilk tests were used for this purpose. The analysis leads to the conclusion that the distributions of the variables are characterized by a pronounced left skewness and there is no convergence of the empirical distributions with the normal distribution. With the results obtained, further analyses require using nonparametric tests with continuity correction.

Furthermore, a *p*-value was assumed as a measure of the decision on the significance of group differentiation. If the value of the parameter is less than 0.05, it is assumed that the differentiation of the groups is significant. Values greater than 0.05 mean that despite some variation in the sample, this variation cannot be found to characterize the population. Based on the above assumptions, research methods were grouped and assigned to individual characteristics of organic food processing enterprises, as shown in Tab. 2.

Table 2 provides a summary organizing the data. It also shows that due to the lack of significance of indicators in some subgroups and also insufficient sample size, there are barriers that make it impossible to draw firm conclusions, and although there is some variation in the subgroup studied, it still cannot be the basis for describing the population studied. For this reason, from the population of enterprises declaring organic and conventional food processing in their scope of activities (Table 1, column 2), those entities that indicated: a different form of capital (0.39%), duration of operation of up to 2 years (1.93%), local scope of operations (1.16%) were excluded from further analysis.

Similarly, from the population of enterprises declaring only organic food processing in their scope of operations (Table 2, column 4), those entities that indicated: medium and large size of their enterprise (2.70%, 0.00%), duration of operation of up to 2 years (0.77%) and local and regional scope of operations (0.78%, 3.88%) were excluded from further analysis. The inadequate size of some subgroups and, consequently, the lack of significance of capital differentiation was the reason why further estimations taking into account this characteristic of the entities were abandoned.

The above analysis became the basis for further statistical estimates relating to the set of improvement activities included in Tab. 1. However, it was assumed that the study would present the results in which, due to the group sizes, it was possible to verify the differentiation.

In the group of enterprises engaged only in organic food production (Table 2, column 4), it was noted that verification of differentiation by enterprise size was possible only in the group of micro and small enterprises.

Table 2

Differentiation of sample structure with the assignment of research methods

Layer in the class of food producers n = 259	**Enterprises producing conventional and organic food (mixed profile)**	**Research method**	**Enterprises producing only organic food (organic food profile)**	**Research method**
ENTERPRISE SIZE				
Micro-enterprise (up to 10 employees)	**19.31%**	Kruskal-Wallis ANOVA	**13.90%**	Mann-Whitney U test
Small enterprise (10 to 49 employees)	**23.94%**		**5.79%**	
Medium-sized enterprise (from 50 to 249 employees)	**26.25%**		2.70%	not included in the analysis
Large (more than 250 employees)	**8.11%**		0.00%	
CAPITAL				
Polish-foreign capital	**7.81%**	Kruskal-Wallis ANOVA	0.39%	Due to the inadequate size of subgroups other than 100% Polish capital, intergroup comparisons are not possible.
100% foreign	**9.77%**		1.56%	
100% Polish	**59.38%**		**20.70%**	
Another form, which?	0.39%	not included	0.00%	
DURATION OF OPERATION				
Up to 2 years	1.93%	not included	0.77%	not included in the analysis
3-5 years	**4.25%**	Kruskal-Wallis ANOVA	**5.02%**	Kruskal-Wallis ANOVA
6-10 years	**10.81%**		**5.41%**	
Over 10 years	**60.62%**		**11.20%**	
SCOPE OF OPERATIONS				
Local	1.16%	not included	0.78%	not included in the analysis
Regional	**5.43%**	Kruskal-Wallis ANOVA	3.88%	
National	**19.38%**		**7.75%**	Mann-Whitney U test
International	**51.55%**		**10.08%**	

Values with a significant percentage of the group in the sample are highlighted in bold and used for further analysis.

Interestingly, this characteristic differentiates the perception of the laboratory's operation (Q5.03) and its impact on quality improvement activities in the entities surveyed (*p-value* = 0.021), as shown in Figure 1.

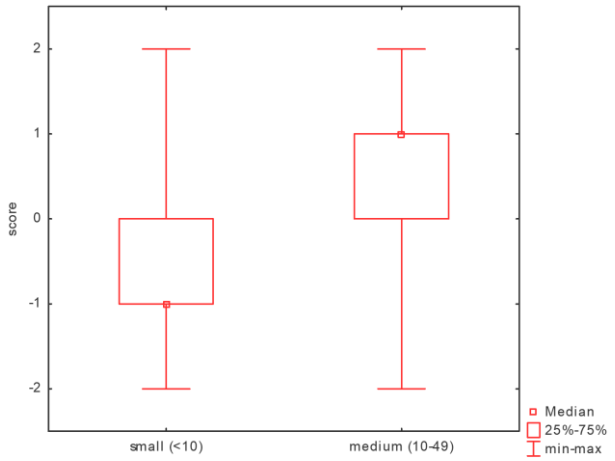

Fig. 1 Comparison of the assessment of the laboratory's effect on quality improvement activities for micro- and small enterprises

As illustrated in Figure 1, the laboratory's operation definitely has a clear impact on quality improvement in small enterprises, with a rating above 1. This is indicated by the median value. In addition, the chart's box, denoting the 50% portion of the designated subgroup, suggests that the assessment of the laboratory's effect on quality in small enterprises is positive. Micro-entrepreneurs made the opposite assessment. According to them, the operation of the laboratory is unlikely to affect the quality of production. In this case, the median was -1.

Another analysis of the data leads to the conclusion that within the same group of entities engaged only in organic food processing, it is additionally possible to verify the differentiation only between enterprises with a domestic or international scope. After analysis of the answers given by representatives of the enterprises studied, it turned out that the attribute of the scope of the enterprise operations and enterprise size (see Figure 1) differentiates the assessment of the impact of the laboratory's operation on quality improvement *(p-value* = 0.01), as shown in Figure 2.

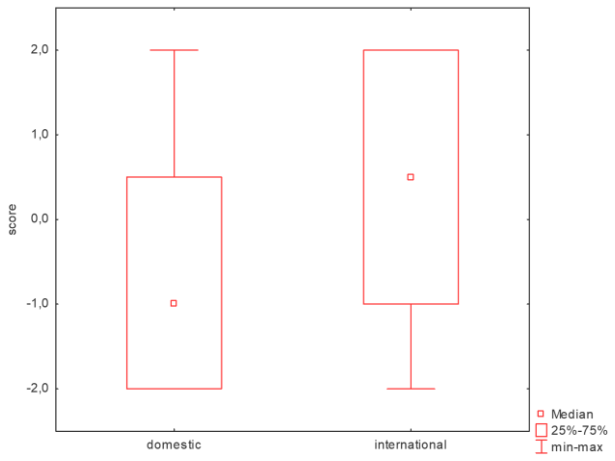

Fig. 2 Comparison of the assessment of the impact of the laboratory's operation between enterprises with the domestic and international scope of operations

As highlighted in Figure 2, for enterprises with an international scope of operations, an important element affecting quality improvement activities is the laboratory. Interestingly, Enterprises with a national scope are inclined to rate this aspect as little important, with a median value of -1, or even as unimportant (-2). This is indicated by the position of the chart box.

In the course of further statistical testing, it was found that there were no significant differences in the assessed aspects listed in Tab. 1 – in terms of enterprise characteristics, such as the duration of operation or enterprise capital. In both cases, the variation was statistically insignificant, which means that the formation of quality in enterprises does not depend on either the duration of operation in the market or the form of capital. They were rated similarly by respondents. The publication omits the presentation of statistically insignificant results.

The situation was quite different with enterprises processing both conventional and organic food (see Table 2, column 2). As the research revealed, the size of business entities is an important differentiating factor for the group of food processors studied in terms of the increase in the number of training courses that affect quality improvement activities (Q5.11). A detailed analysis is presented in Tab. 3.

Table 3

Enterprise size vs. assessment of the impact of the number of training courses on quality improvement activities using the Kruskal-Wallis test

Dependent variable: Q5.11	**Q5.11. With the increase in the number of quality-related training courses Kruskal-Wallis test: H (3, N= 200) = 13.71734 p =.0033**			
	Code	**N valid**	**Rank sum**	**Mean rank**
Microenterprise (up to 10 employees)	1	50	4673.000	93.4600
Small enterprise (10 to 49 employees)	2	62	5310.000	85.6452
Medium-sized enterprise (from 50 to 249 employees)	3	68	7494.500	110.2132
Large enterprise (more than 250 employees)	4	20	2622.500	131.1250

The *p-value* for the Kruskal-Wallis test shows that at least one subgroup may have a significantly different median value than the others. Therefore, it is necessary to conduct *post-hoc* multiple comparison tests. It turns out that they differentiate between two subgroups, as presented in Tab. 4.

The results of statistical testing included in Table 4 show the differentiation between the subgroups of large and small enterprises. With large enterprises, an increase in the number of quality-related training courses is essential for quality improvement activities (Q5.11) (the median is 2 in this case). The other subgroups of enterprises

characterized by their size do not show significant differences. It can be assumed that in their case, the median rating is 1.

Table 4
Enterprise size vs. assessment of the impact of the number of training courses on quality improvement activities using the multiple comparison test

Dependent variable: Q5.11	p-value for multiple (two-way) comparisons			
	Micro-enterprise (up to 10 employees) R:93.460	Small enterprise (10 to 49 employees) R:85.645	Medium-sized enterprise (from 50 to 249 employees) R:110.21	Large enterprise (more than 250 employees) R:131.13
Micro-enterprise (up to 10 employees)		1.000000	0.721497	0.083452
Small enterprise (10 to 49 employees)	1.000000		0.093821	**0.013475**
Medium-sized enterprise (from 50 to 249 employees)	0.721497	0.093821		0.933029
Large enterprise (more than 250 employees)	0.083452	**0.013475**	0.933029	
Values that show significant variation between subgroups are in bold				

Therefore, this was also an important aspect for these subgroups but not as important as in large enterprises.
Further statistical analysis entitles us to the observation that the characteristic related to the origin of capital of the entities studied (see Table 2, column 2) is a variable that differentiates perceptions of quality improvement only in the aspect of the intensity of innovative thinking (Q5.10). The other factors presented in Tab. 1 are at the same levels in the study sample, regardless of the type of capital.

Table 5
Comparison of the assessment of the impact of employees' innovative thinking on quality improvement activities in enterprises with different capital structures using the Kruskal-Wallis test

Dependent variable: Q5.10	Q5.10. With the increase of innovative thinking of employees in the context of quality improvement Kruskal-Wallis test: H (2, N = 197) =11.68915 p =.0029 Condition of inclusion: V1 = 1 and (V3 = 1 or V3 = 2 or V3 = 3)			
	Code	N valid	Rank sum	Mean rank
Polish-foreign capital	1	20	1309.00	65.4500
100% foreign	2	25	2121.50	84.8600
100% Polish	3	152	16072.50	105.7401

Tabs. 5 and 6 summarize figures describing the issue addressed in detail.

Table 6
Comparison of the assessment of the impact of employees' innovative thinking on quality improvement activities in enterprises with different capital structures using the multiple comparison test

Dependent variable: Q5.10	p-value for multiple (two-way) comparisons, Q5.10 (BAZA_ANALIZA) Independent (grouping) variable: P4 Kruskal-Wallis test: H (3, N= 198) =12.88990 p =.0049 Condition of inclusion: V1=1			
	Polish-foreign capital R:66,025	100% foreign R:85.640	100% Polish R:106.58	Another form, which? R:40.000
Polish-foreign capital		1.000000	**0.017573**	1.000000
100% foreign	1.000000		0.542883	1.000000
100% Polish	**0.017573**	0.542883		1.000000
Values that show significant variation between subgroups are in bold.				

The analysis showed (see Tab. 5 and 6) that significant differences exist between enterprises with sole Polish capital and those with mixed capital. Figure 3 was prepared to complement the outlined situation.

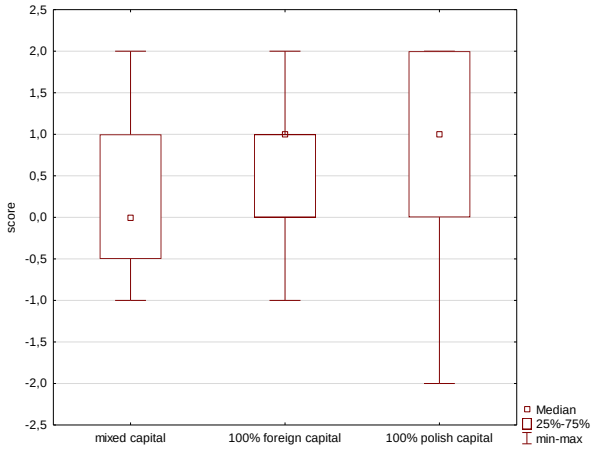

Fig. 3 Comparison of the assessment of the impact of employees' innovative thinking on quality improvement activities in enterprises with different capital structures

From the data in Figure 3 it can be seen that innovative thinking in the context of quality improvement (Q5.10) is perceived as more important in enterprises with only Polish capital. This aspect was rated by respondents at level 1 (median position). Furthermore, half of the respondents of this subgroup identified this area as important (rating values above 0) in terms of quality improvement activities. In the other two capital subgroups (foreign and mixed), this aspect was rated as moderately important, and even less important in the case of mixed capital, as half of the respondents rated its importance below 0, as evidenced by the position of the median.

It is also worth noting that for enterprises producing both conventional and organic foods (Table 2, column 2), the characteristic that assigned them in terms of their duration of operation in the market significantly differentiated the perception of quality improvement activities in areas related to:

1) overall coordination of efforts to improve product quality in all departments of the enterprise (Q5.01) (see Figure 4),
2) increase in quality-related training courses (Q5.11) (see Figure 5).

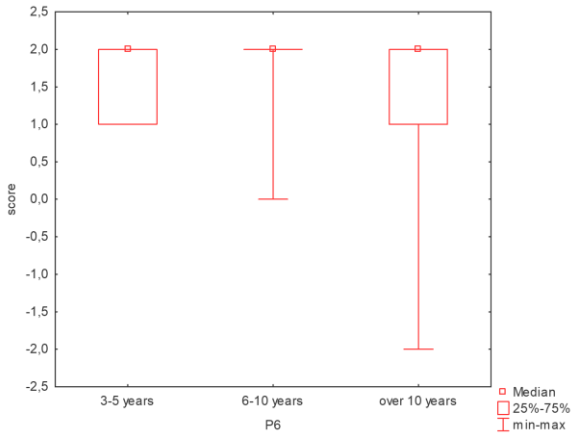

Fig. 4 Comparison of the effect of overall coordination of activities to improve product quality in all departments of the enterprise in terms of the duration of operation in the market

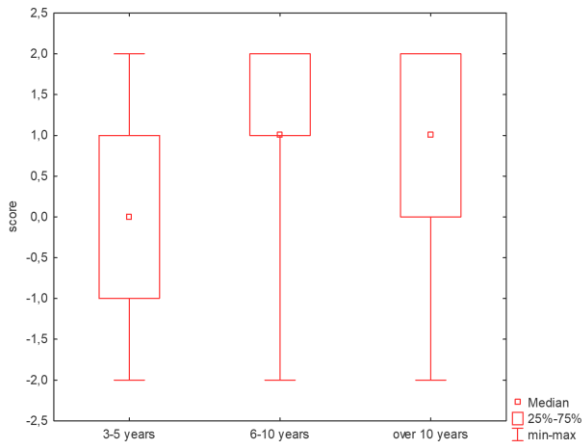

Fig. 5 Comparison of the effect of the increase in the number of training courses on quality improvement in terms of the duration of operation of the enterprise

As can be seen in Figure 4, according to respondents, the aspect of overall coordination of efforts to improve quality was rated higher in enterprises operating in the market for 6 to 10 years. It should be noted that for this subgroup of enterprises, this aspect is very important, as evidenced by ratings of 2. This is particularly evident when compared with the ratings of enterprises operating in the market for more than 10 years. This is demonstrated by the significance evaluated in the Kruskal-Wallis test (p = 0.007) and multiple comparisons tests (p = 0.03). At the same time, there was a significant percentage of respondents in this subgroup who rated the overall coordination of efforts to improve quality (see box size) at a lower level. It is this stratum of respondents (who rated this aspect relatively lower) that shows the differences between the two subgroups. Interestingly, in the subgroup of enterprises operating in the market for 3 to 5 years, due to the wide variety of respondents' assessments, there is no statistical basis to conclude unequivocally that the situation in this subgroup is different from the other two.

The following Figure 5 shows the perception of the increase in the number of quality-related training courses affecting quality improvement (Q5.11) differentiated by the time of operation of the enterprise in the market.

As can be seen from Figure 5, the aspect related to the number of training courses that affect quality improvement (Q5.11) is clearly perceived differently in the two subgroups of the enterprises. This differentiation is very evident when comparing the assessed area in enterprises operating in the market for 3 to 5 years with those operating for 6 to 10 years. The Kruskal-Wallis test shows a parameter value of p = 0.016, and the test of multiple comparisons is estimated at p = 0.02. For enterprises with short duration of operation, the increase in the number of training courses had a relatively neutral effect on activities to improve quality. However, it should be emphasized that the median, in this case, was zero, and the box is symmetrical. This means a relative balance of positive and negative ratings. Significantly more respondents representing enterprises that have been operating for more than 5 years gave positive ratings. This leads to the conclusion that enterprises operating longer in the market place more importance on the number of training courses perceived as an important stimulant of quality improvement activities in their organization.

Statistical analysis showed that the aspect related to the impact of the laboratory's operation on quality improvement not only in enterprises engaged solely in organic food production (see Tab. 2, column 4, and Figs. 1 and 2) but also in those with a mixed production profile (see Tab. 2, column 2) is an important issue. Its perception varies depending on the scope of operations of the entities studied. This is illustrated in detail in Figure 6.

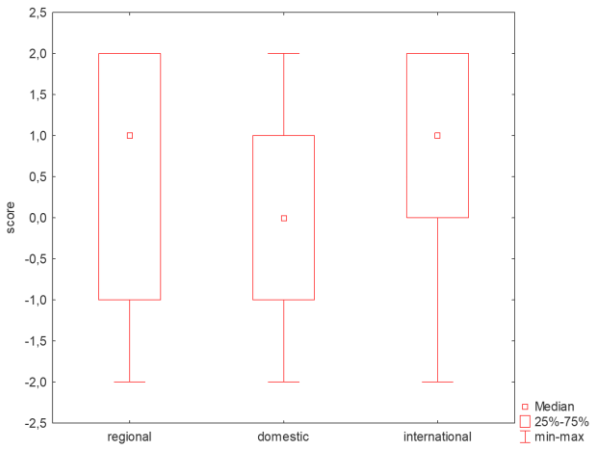

Fig. 6 Comparison of the assessment of the effect of the laboratory on quality improvement in terms of the scope of operations in entities engaged in mixed food processing

With the data shown in Figure 6, it is legitimate to conclude that regional processors have very diverse and inconsistent opinions about the laboratory's effect on quality improvement activities. This is an obstacle that makes it impossible to make comparisons of perceptions of this area with other subgroups. More precise ratings in these terms were given by domestic enterprises. They rated the laboratory's effect on quality improvement as less important (median = 0) compared to the assessment of those with international scope (median = 1). Furthermore, it can be assumed that in domestic enterprises, negative and positive assessments, due to the symmetry of distribution (see box) cancel each other out. As for multinational enterprises, on the other hand, positive ratings were given by at least half of the respondents (box 50% above 0). Thus, in general, it should be recognized that the laboratory is a significant component of quality improvement activities for entities with international scope, which significantly differentiates them from enterprises with national scope.

The overall statistical analysis allows a general conclusion that the characteristics of the enterprises studied such as the origin of capital, scope and duration of operation, and their size affect the assessment of certain quality improvement activities. Interestingly, in enterprises with organic food processing profile, most of the areas (Tab. 1), for methodological reasons (Tab. 2), could not be assessed. However, based on the U-Mann-Whitney test in the statistical analysis of the collected data, significantly different ratings in aspects of quality improvement activities can be compared in tables between producers engaged solely in the production of organic food and producers with a mixed production profile (organic+conventional), as highlighted in Tab. 7.

Based on the data presented in Tab. 7, only four of the eleven (see Tab 1) of the assessed aspects should be separated from the statistical point of view, with their perception clearly different among producers specializing solely in the production of organic food and producers with a mixed production profile (organic+conventional). These areas are mainly related to:

- laboratory operation (Q5.03),
- technological process improvement (Q5.04),
- an increase in the number of quality-related training courses (Q5.04).

Although in Tab. 7 median values for Q5.04 and Q5.11 are the same for both groups of enterprises studied, based on the detailed results, the distributions of the variables indicate that for enterprises with a mixed business profile, these two aspects are important for quality improvement. Focusing attention on process improvement (Q5.04) and quality-related training courses (Q5.11) in business entities that produce organic food in addition to conventional food can have a key impact on quickly identifying opportunities and seizing them for their growth and development [28]. The simultaneous production of organic and conventional products by the enterprises studied requires them to display shrewdness, flexibility, intelligence, and cunning, which, as Trzcieliński [56] argued, are qualities synonymous with agility.

Table 7

Summary of statistically significant assessments of aspects of quality improvement in terms of the business profile of enterprises using the U-Mann-Whitney test

Quality aspect	Enterprises producing conventional and organic food (mixed profile)		Enterprises producing only organic food (organic food profile)		Results of using the test			
	rank sum	median	rank sum	median	Z	p	N signif.	N signif.
Q5.03. With the operation of the laboratory	27653.5	1	5757.5	0	**3.609**	**0.000**	200	58
Q5.04. With the improvement of the technological process	26710.5	1	6442.5	1	**2.227**	**0.026**	199	58
Q5.11. With the increase in the number of quality-related training courses	26973.0	1	6438.0	1	**2.248**	**0.025**	200	58

It is worth noting that the issues of organic food processing in Poland were addressed in the study by Dziuba et al. [54], who indicated the legal and organizational conditions for the production of this type of food and emphasized the legitimacy of implementing solutions contained in the idea of agility. Therefore, the research results highlight the importance of quality and its multifaceted improvement as an important element in creating agile behavior in such enterprises.

CONCLUSION

Statistical data [57, 58, 59] show that the agri-food sector, despite the economic turmoil caused by armed conflicts and pandemics, can flexibly adapt to the changing expectations of buyers and is one of the fastest-growing branches of the economy not only in Poland but also in the world. Despite the difficult geopolitical situation, recovery is also being recorded in the niche market of organic food. Enterprises wishing to offer such products must exhibit agile behaviors that include the ability and speed to reconfigure resources, flexibility, and care in meeting customer needs and responsibility for product quality. These aspects cannot be considered in isolation from continuous quality improvement activities, which, if carried out systematically within an enterprise, allow for staying ahead of the competition faster and more

effectively, and capturing emerging market opportunities resulting from changing customer expectations, thus bringing real benefits to all stakeholders.

The research described in the present study fits into this narrative thread. It showed that there are significant differences in the assessment of quality improvement activities in terms of their agility, not only between the two groups of producers (those with organic food processing profile and those that produce both organic and conventional foods) but also in terms of the difference in the two groups of producers in capital, scope and duration of operation, and enterprise size.

The results presented in the study lead to the conclusion that, especially in enterprises with a mixed food processing profile, there are statistically significant differences in the perception of quality improvement activities. The results of the research work presented in this study also demonstrate the need for further theoretical and empirical exploration of the operation of organic food processing enterprises. It is worth examining this type of enterprises in detail from the standpoint of their perception of the role of the laboratory and training in quality improvement activities.

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REFERENCES

[1] I. Ansof. *Zarządzanie strategiczne*. Warsaw: Państwowe Wydawnictwo Ekonomiczne, 1985.

[2] J. P. Davis, K. M. Eisenhardt, C. B. Bingham. „Optimal structure, market dynamism, and the strategy of simple rules". *Administrative Science Quarterly*, vol. 54, no. 3, 2009, pp. 413-452.

[3] P. F. Drucker. *Myśli przewodnie Druckera*. Warsaw: Wydawnictwo MT Biznes, 2001.

[4] N. Zahoor, I. Golgeci, L. Haapanen, I. Ali, A. Arslan. A. „The role of dynamic capabilities and strategic agility of B2B high-tech small and medium-sized enterprises during COVID-19 pandemic: Exploratory case studies from Finland". *Industrial Marketing Management*, vol. 105, 2022, pp. 502-514.

[5] A. Kriz, R. Voola, U. Yuksel. U. „The Dynamic Capability of Ambidexterity in Hypercompetition: Qualitative Insights". *Journal of Strategic Marketing*, vol. 22, no. 4, 2014, pp. 287-299.

[6] C. L. Bausch, G. S. Milan, A. P. Graciola, L. Eberle, S. Bebber. „The COVID-19 pandemic and the changes in consumer habits and behaviour". *Gestao E Desenvolvimento*, vol. 18 (3), 2021, pp. 3-25.

[7] A. Nanda, Y. Xu, F. Zhang. „How would the COVID-19 pandemic reshape retail real estate and high streets through acceleration of E-commerce and digitalization?" *Journal of Urban Management*, vol. 10(2), 2021, pp. 110-124.

[8] R. M. Grant R M. *Współczesna analiza strategii*. Warsaw: Wolters Kluwer, 2011.

[9] R. P. Rumelt. „How much does industry matter?" *Strategic Management Journal,* vol. 12(3), 1991, pp. 167-185.

[10] L. Cao. „Dynamic Capabilities in a Turbulent Market Environment: Empirical Evidence from International Retailers in China". *Journal of Strategic Marketing*, vol. 19, no. 5, 2011, pp. 455-469.

[11] J. Singh, H. Singh. „Continuous improvement approach: atate-of-art review and future implications". *Int. J. Lean Six Sigma,* vol. 3, 2012, pp. 88-111.

[12] M. Kumar, J. Antony. „Comparing the quality management practices in UK SMEs". *Ind. Manage. Data System*, vol. 108, 2008, pp. 1153-1166.

[13] R. L. Matthews, P. E. Marzec. „Continuous, quality and process improvement: disintegrating and reintegrating operational improvement?" *Total Quality Management & Business Excellence*, vol. 28 (3-4), 2017, pp. 296-317.

[14] M. Imai. *Kaizen. Klucz do konkurencyjnego sukcesu Japonii*. Warsaw: MT Biznes, 2007.

[15] K. Szczepańska. „Doskonalenie i samoocena w zarządzaniu jakością w przedsiębiorstwie". *Problemy Zarządzania*, vol. 2, no. 37, 2015. pp. 9-27.

[16] M. L. Jacques. „The call of quality: doing right things right", *Quality Progress*, vol. 32(9), 1999, pp. 48-54.

[17] K. E. Maani, M. S. Putterill, D. G. Sluti. „Empirical analysis of quality improvement in manufacturing". *International Journal of Quality & Reliability Management*, vol. 11(7), 1994, pp. 19-37.

[18] M. Ingaldi. „E-Service quality assessment according to hierarchical service quality models". *Management Systems in Production Engineering*", vol. 30(4), 2022, pp. 311-318.

[19] A. P. Kedar, R. R. Lakhe, V. S. Deshpande, P. V. Washimkar, M. V. Wakhare. „A comparative review of TQM, TPM and related organisational performance improvement programs" in *Proceedings – 1st International Conference on Emerging Trends in Engineering and Technology*, ICETET 2008, 2008, pp. 725-730.

[20] M. D. Hutchins, M. D. *Hoshin Kanri: the strategic approach to continuous improvement*. London: Gower Publishing, Ltd. 2012.

[21] J. Karpacz. „Determinanty dostrzegania i wykorzystania okazji przez przedsiębiorców" in Koncepcja zarządzania współczesnym przedsiębiorstwem, A. Stabryła (ed.), seria „Encyklopedia Zarządzania". Kraków: Mfiles.pl, 2010, pp. 45-52.

[22] W. A. Nafei. "Organizational Agility: "The Key to Organizational Success". *International Journal of Business and Management*, vol. 11, no. 5, 2016, pp. 296-309.

[23] Yusuf Y.Y., Sarhadi M., Gunasekaran, A. "Agile manufacturing: The drivers, concepts and attributes". *International Journal of Production Economics*, vol. 62, no. (1-2), 1999, pp. 33-43.

[24] Iacocca Institute. *21st century manufacturing enterprises strategy: An industry-led view*, vol. 1, no. 2, 1991.

[25] R. J. Vokurka, G. Fliedner. "The journey toward agility". *Industrial Management & Data Systems*, vol. 98 no. 4, 1998, pp. 165-171.

[26] P. Swafford, S. Ghosh, N. Murthy. "The antecedents of supply chain agility of a firm: Scale development and model testing". *Journal of Operations Management*, vol. 24, 2006, pp. 170-188.

[27] S. Devadasan, S. Goshteeswara, J. Gokulachandran. "Design for quality in agile manufacturing environment through modified orthogonal array-based experimentation". *Journal of Manufacturing Technology Management*, vol. 16, no. 6, 2005, pp. 576-597.

[28] R. I. Van Hoek, A. Harrison, M. Christopher. "Measuring agile capabilities in the supply chain". *International Journal*

of Operations & Production Management, 2001, pp. 126-148.
[29] B. Maskell. "The age of agile manufacturing". *Supply Chain Management: An International Journal*, vol. 6, no. 1, 2001, pp. 5-11.
[30] A. M. Hormozi. "Agile manufacturing: the next logical step". Benchmarking: An International Journal, vol. 8, no. 2, 2001, pp. 132-143.
[31] A. Gunasekaran, Y. Y. Yusuf. "Agile manufacturing: a taxonomy of strategic and technological imperatives". *International Journal of Production Research*, vol. 40, no. 6, 2002, pp. 1357-1385.
[32] Y. Y. Yusuf, E. O. Adeleye, K. Sivayoganathan. "Volume flexibility: the agile manufacturing conundrum". *Management Decision*, vol. 41 no. 7, 2003, pp. 613-624.
[33] A. Oyedijo. "Strategic agility and competitive performance in the Nigeria telecommunication industry. An empirical Investigation". Business and Management Review, no. 12, 2012, pp. 227-237.
[34] D. Vazquez-Bustelo, L. Avella, E. Fernandez. "Agility drivers, enablers and outcomes: Empirical test of an integrated agile manufacturing model". International Journal of Operations and Production Management, vol. 27, no. 12, 2007, pp. 1303-1332.
[35] S. Meredith, D. Francis. "Journey towards agility: the agile wheel explored". *The TQM Magazine*, vol. 12 no. 2, 2000, pp. 137-143.
[36] Z. Zhang, H. Sharifi. "A methodology for achieving agility in manufacturing organisations". *International Journal of operations & Production management*, vol. 20, no. 4, 2000, pp. 496-513.
[37] Crocitto M., Youssef M., "The human side of organizational agility". *Industrial Management & Data Systems*, vol. 103, no. 5, 2003, pp. 388-397.
[38] A. Stachowiak, P. Cyplik. „Aspekt dojrzałości do zwinności w definiowaniu strategii zwinności przedsiębiorstwa". Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu, no. 505, 2018, pp. 203-215.
[39] J. Singh, H. Singh. „Continuous improvement philosophy – literature review and directions". *Benchmarking: An International Journal*, 2015, pp. 75-119.
[40] S. Vinodh, J. Antony, R. Agrawal, J. A. Douglas. „Integration of continuous improvement strategies with Industry 4.0: a systematic review and agenda for further research". *The TQM Journal*, vol. 33(2), 2021, pp. 441-472.
[41] J. A. F. Stoner, R. E. Freeman, Jr., D.R. Gilbert. *Kierowanie*. Warszawa: Polskie Wydawnictwo Ekonomiczne, 1997.
[42] M. Imai. *Gemba Kaizen. Zdroworozsądkowe podejście do strategii ciągłego rozwoju*. Warszawa: MT Biznes, 2012.
[43] J. Bessant, S. Caffyn, M. Gallagher. „An evolutionary model of continuous improvement behaviour". *Technovation*, vol. 21(2), 2001, pp. 67-77.
[44] A. Hamrol. *Zarządzanie i inżynieria jakości*. Warsaw: Wydawnictwo Naukowe PWN, 2017.
[45] S. Han, P. K. Roy, M. I. Hossain, K. H. Byun, C. Choi, S. D. Ha. „COVID-19 pandemic crisis and food safety: Implications and inactivation strategies". *Trends in Food Science & Technology*, no. 109, 2021, pp. 25-36.
[46] *WHO global strategy for food safety 2022-2030: towards stronger food safety systems and global cooperation*. World Health Organization, 2022.
[47] Ustawa z dnia 23 czerwca 2022 r. o rolnictwie ekologicznym i produkcji ekologicznej (DZ. of Laws 2022, Pos. 1371).
[48] D. Kołożyn-Krajewska (ed.). *Higiena produkcji żywności*. Warszawa: Wydawnictwo SGGW, 2019.
[49] T. Nielsen. „Minimal and Careful Processing. In: O. Schmid, A. Beck, U. Kretzschmar (ed.) *Underlying Principles in Organic and "Low-Input Food" Processing: Literature Survey*. Frick, Switzerland: Research Institute of Organic Agriculture FiBL, 2004, pp. 36-38.
[50] J. Kahl, F. Alborzi, A. Beck, S. Bügel, N. Busscher, U. Geier, A. Załęcka. „Organic food processing: a framework for concept, starting definitions and evaluation". *Journal of the Science of Food and Agriculture*, vol. 94(13), 2014, pp. 2582-2594.
[51] M. Gableta, S. Dziuba. „Czynniki rozwoju przetwórstwa ekologicznego ze szczególnym uwzględnieniem praktyk zarządczych w młynie". *Zarządzanie i Finanse*, vol. 16, nr 1/1, 2018, pp. 17-26.
[52] L. Parrenin, C. Danjou, B. Agard, B. Beauchemin. „Future trends in organic flour milling: the role of AI". *AIMS Agriculture and Food*, vol. 8(1), 2023, pp. 48-77.
[53] P. K. Nicholas, S. Padel, S. P. Cuttle, S. M. Fowler, M. Hovi, N. H. Lampkin, R. F. Weller. „Organic dairy production: a review". *Biological Agriculture & Horticulture*, vol. 22(3), 2004, pp. 217-249.
[54] S. Dziuba, A. Szczyrba. "Agile management in Polish organic food processing enterprises". *Production Engineering Archives*, vol. 29, no. 1, 2023, pp. 101-107.
[55] Rozporządzenie Parlamentu Europejskiego i Rady (UE) 2018/848 z dnia 30 maja 2018 r. w sprawie produkcji ekologicznej i znakowania produktów ekologicznych.
[56] S. Trzcieliński. *Przedsiębiorstwo zwinne*. Poznań: Wydawnictwo Politechniki Poznańskiej, 2011.
[57] https://www.mckinsey.com/pl/our-insights/state-of-grocery-retail.
[58] https://www.paih.gov.pl/sektory/spozywczy.
[59] https://www.portalspozywczy.pl/zboza/wiadomosci/rynek-zywnosci-ekologicznej-rosnie-w-polsce-bardzo-dynamicznie,211251.html.

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