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IMPLEMENTATION OF FOREIGN EXPERIENCE IN PRODUCT QUALITY MANAGEMENT INTO DOMESTIC COMPANIES

Abstract: *The research objective includes a set of processes performed to build up the quality management system. Theoretical, methodical, and practical aspects of quality management make up this research subject matter. The key objective of this article is to develop guidelines targeted at the management process improvement. Revealing non-conformities and finding out corrective actions for quality enhancement make up the necessary stage for the achievement of the major objective. For this purpose it would be useful to analyze the activity of the Ukrainian fat-and-oil company and find out the advantages of the foreign system implementation, proposing the implementation of the Hazard Analysis and Critical Control Points (HACCP) system, performing an expert review of a set of certain criteria for the company activity evaluation, determining the assessment parameters for every structural component of the system, using Polli-Cook technique for the determination of HACCP system life cycle phase, making administrative decisions targeted at the improvement of the system formation and development processes.*

Keywords: *Polli-Cook model, industrial policy, fat-and-oil industry, food industry, quality management systems*

1. Introduction

The primary hypothesis is that one proposed by Ukrainian researcher Osadciuk OP, who considers Polli-Cook technique to be a method that may be used to solve the issues associated with an increase of functional performance of the domestic dairy companies via identification of hazards and potential opportunities for the industrial branch growth, and improvement of domestic foodstuff quality at all life cycle phases (Osadciuk, 2015).

The secondary hypotheses are those proposed by Slovak researchers Simo and Mura (2015), Soltes (2015) and Subertova (2015). They define the main force driving the implementation of the modern quality management systems (at Slovak companies) as a complexity of their action subsystems based on the optimization of product recycling expenses, reduction of cost price, improvement of the company image, ensuring the long-term development in the conditions of uncertainty.

Though, many theoretical and practical issues in the quality management remain unsolved. Currently, no consideration is given to the implementation of the quality management systems via conducting a certain plan of organizational actions, which assumes an integrated combination of two

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trends: a change in certain aspects of economic activity and reorientation of some management subsystems taking into account the priority of the quality management processes based on the worldwide known Polli-Cook technique; and the establishment of a set of the new subsystems regulated by the requirements of the applicable international standards.

Thus, the issue of the modern quality management system formation and implementation is thought to be highly relevant and prevalent in the industrial, technical, and scientific areas of the public activities. The issues related to the system formation and implementation at the Ukrainian fat-and-oil companies (Zybareva et al., 2016) seem to be of great importance and relevance.

Summary and analysis of the domestic (Osadciuk, 2015; Zybareva et al., 2016) and foreign approaches (Ankudinov and Lebedev, 2014; Ahmetova et al., 2015; Khamidullina and Puryaev, 2016; Ashnai et al., 2016; Balle et al., 2016; Chen et al., 2015; Goraczkowska, 2015; Garcia-Granero et al., 2014; Hewitt-Dundas and Roper, 2017; Istomina and Fedorova, 2014; Kusumano, 2016; Kryvoruchko and Krukhmal, 2015; Kozubikova and Zoubkova, 2016; Lazanyi, 2014; Lomyichuk, 2015; Lurie and Pedreschi, 2014; Love et al., 2014; Menon, 2015; Matzler et al., 2015; Ob'yedineniye predpriyatiy po proizvodstvu I pererabotke rastitel'nykh masel i zhirov; Obradovic and Obradovic, 2016; Orlov et al., 2015; Pahlova, 2015; Rezer, 2014; Roper and Hewitt-Dundas, 2016; Sheree, 2016; Simo and Mura; 2015; Soltes, 2015; Subertova et al., 2015; Vahter et al., 2014; Vahter and Efthyvoulou, 2016; Vhinston and Segal, 2016) to the formation and implementation of foreign systems at the companies were used to determine the major areas of their implementation at the Ukrainian fat-and-oil companies: the analysis of both external and internal environmental factors; assessment of the company industrial and economic activity; decision-making regarding quality management system development and implementation; training the skilled quality management personnel; the analysis of the company management structure; determination of the system structure; identification of the processes covered by the system; identification and establishment of relations between certain processes; preparing the list of effectiveness parameters and characteristics; the development of quality monitoring system for the economic activity.

Currently, the experience of the developed countries is used insufficiently for the business improvement of the domestic companies, as our country requires the development of a well-defined project targeted at the development of competitive position strategy for the food industry via the introduction of modern quality management systems and implementation of the public control based on the management principles (Istomina and Fedorova, 2014). In order to solve these issues, we suggest improving the foreign programmes of public support for the companies and develop one competitive program based on their combination.

We offer a practical research, which would contribute to the world science, in the form of two correlated techniques: an expert assessment to determine the quality management system functioning and the adaptation of the word known, but rarely used in the industry Polli-Cook technique to determine the system life cycle phases, currently not commonly used by both domestic and foreign fat-and-oil companies.

2. Materials and methods

A logical method was used to determine the assessment procedure for the quality management system, it comprises as a set of correlated processes used to define the research objectives.

An abstract research method was necessary to determine the criteria for the assessment

of the current situation in Ukraine in the sunflower-seed oil sales on the international market.

A system method was used to analyze both external and internal environmental factors related the industrial policy development.

An economic and statistical method was used for the assessment of the following factors: dynamics of changes associated with the product quality; dynamics of the planned and actual parameters of sunflower-seed oil manufacture by PJSC ChMK; the company industrial and economic activity; decision-making regarding the quality management system implementation.

A graphic method was used for identification of effectiveness parameters and performance characteristics of sunflower-seed oil production in Ukraine.

An analysis and synthesis method was used for the development of the company product quality monitoring system (revealing of non-compliances and corrective actions).

An expert evaluation method (Delphi method) was used to establish an expert group involved in the research and analytical assessment of the performance of both quality management system and adapted Polli-Cook technique.

Polli-Cook technique was used to determine the value of dependent variables following the law of mathematical μ-expectation and mean-square deviation σ, which allows making a highly precise decision regarding certain actual phases of the system life cycle.

A comparison method was used to compare the data associated with the implementation by companies of the modern systems.

The research focused on the Ukrainian company, i.e. public joint-stock company (PJSC) Chernovitsky Maslozhirovoy Kombinat (ChMK) involved in sunflower-seed oil production. The data covers the company reporting period from 2013 to 2015.

The experiment was arranged as follows. On the basis of the hypothesis that assumes Polli-Cook technique application the following goal was set up: to evaluate a set of certain criteria used to determine how the quality management system is implemented and further developed using Delphi expert method; to calculate weight coefficients for the whole set of estimation criteria, weighed estimation of the main system components, integral index to determine the system status; and to determine the extent of expert opinion consistency.

The experiment stages were as follows: determination of the expert group composition (10 experts from the quality department, approved by the order signed by Fesyuk VM, CEO, PJSC ChMK); analytical calculations; expert assessment of a set of criteria, each was scored using a certain number of points (poor performance - 1 point, excellent performance - 10 points).

The experts ranked the estimation criteria for each individual component of the quality management system in order to determine to what extent each of them affects the component investigated. The most significant criterion was ranked as 1, the next criterion in the order of its importance was ranked as 2 and so on in order to assess the criteria within each structural component.

The experts ranked the main system structural components to determine the extent of their effect on the overall entity status (the most significant component was ranked as 1, the least significant as 9).

The concordance factor is known to be useful to determine the coordination of actions performed by the experts and reliability of their assessments within this research, since the experts evaluated a set of criteria, rather than one criterion (Istomina and Fedorova, 2014). The concordance factor varied from 0 to 1. The higher the significance is, the higher the level of expert opinion consistency is. The weighed estimates for all structural components of the system were made, and the model was developed to determine the integral index.

This article contains the final assessment result.

3. Literature review

In the view of the relevance of this research subject matter and issues raised here, we reviewed the works of the following researchers in this area: Ankudinov and Lebedev (2014), Ahmetova, Semenova, Kirianova and Lang (2015) investigated parameters of the social and economic environment affecting the region innovative development. They found that there was no balance for the implementation of the quality management system principles at the companies they reviewed.

The works of Khamidullina and Puryaev (2016), Ashnai, Henneberg, Naude and Francescucci (2016) show how the companies use the "lean production" tools that require the quality system implementation.

The works of Chen et al. (2015), Goraszkowska (2015), Garcia-Granero et al., (2014), Hewitt-Dundas and Roper (2017), Istomina and Fedorova (2014), Krivoruchka and Krukhmal (2015), Kozubikova and Zoubkova (2016), Lazanyi K. (2014), Lomyichuk V (2015.), Lurie and Pedresci (2014), Persky and Freiman (2014) analyze the following trends in the modern quality management policy: application of the "lean production" techniques by the domestic and foreign technological parks and innovative activity conducted by the companies within the industrial networks; social risk management; specific features of business management in the conditions of globalization; strategic benchmark for the cross-cultural characteristics of business relations between the Ukrainian companies and Chinese partners.

Balle et al. (2016), Kusumano. (2016), Matzler et al. (2015), Pahlova (2015), Sheree (2016), Simo and Mura (2015), Soltes (2015), Subertova (2015), Vahter and Efthyvoulou (2016) highlight the necessity to manage the industrial activity in compliance with the international standards.

Osadciuk (2015), Zybareva and Iaskal (2016) discuss the domestic experience and its importance for the domestic and world science, for this purpose they analyze the evolution of the domestic systems, described in details in Table 1.

Table 1. Domestic Product Quality Management Systems

Quality system name	Quality management system characteristic
Saratov defect-free manufacture system, (1955)	A set of correlated measures meant to establish the conditions for the manufacturing of defect-free products in compliance with the requirements of the standard documentation.
Gorky system "Quality, reliability, life time of first products", (1958)	Improvement of products at the stage of production technical preparation enables to correct the defects during the serial production.
Lvov defect-free production system, (1961)	Zero-defect operation is adopted as a unit, and all possible operational defects are assessed using the work quality factor.
Yaroslavl system of scientific work organization to increase the motor recourse (1964)	Comprehensive approach to the product quality management based on the planning of its core parameters.
Comprehensive product quality management system, (1975)	A set of measures used to establish the quality level at the main stages of the product life cycle.

*Compiled by the author according to the data from (Osadciuk, 2015; Zybareva, Iaskal, Bezrodna, 2016)

The advantages of these product quality management systems for the domestic and world science are as follows: full responsibility of the direct manufacturer for the production quality; strict compliance with the technical discipline; total control of the product quality and conformity with the applicable documents; technical inspection targeted both at the detection of defective products and development of measures to prevent their occurrence; quantification of the performance of each executive; quality system documentation.

The foreign experience has also its own history of evolution of the systems analyzed by the following researchers: Chen et al. (2015), Garsiya-Granero et al. (2014), Kusumano (2016), Lyubov et al. (2014), Menon (2014), Obradovic Dragisa and Obradovic Dragan (2016), Orlov et al. (2015), Rezer (2014), Roper et al. (2016), Vahter et al. (2014), Vhinston and Segal (2016). These systems include: Taylor's scientific industrial management (1905); statistical quality control system developed by Shewhart et al. (1924); introduction of continuous improvement by Deming (1950); company-wide quality control developed by Ishikawa (1955-1960); total quality management system established by Feigenbaum (1960); zero defects system initiated by Crosby (1964); hazardous factors and critical points analysis, HACCP (1960).

The advantages of these systems for the world product quality management science include: strict control of the manufacturing quality using the methods of mathematical statistics; administrative control of management plan performance; improvement of the company management as a whole; high importance of legal responsibility of manufacturers for the quality; comprehensive analysis of each defect targeted at identification and elimination of its causes, rather than its correction.

Best Ukrainian practice in the product quality management has been accumulated based on the operational experience of various companies in the industrially developed countries. It used to be so until Ukraine started following the market economy principles. As the result of implementation of the quality improvement policy the majority of companies had only in-house standards and remnants of the comprehensive product quality management system. Currently Ukraine develops its own system approach, accumulated and built based on the experience of both Soviet and foreign systems.

We suggest using HACCP system at the domestic industrial entities, thus contributing to the solution of quality improvement issues. This system is applied almost worldwide, as it proved to be efficient, when applied for the elimination of various defects occurred at the manufacturing stage The system is based on the international standards: IFS 2003 "Food products"; BRC 2008 "Food products"; ISO 22000:2005 "Food safety management systems. Requirements for any organization in the food chain", (September 1, 2005); ISO 22001 "Guidelines on application of ISO 9001:2000 for the food and drink industry"; ISO/TS 22002 "Prerequisite programmes on food safety"; ISO/TS 22003 "Food safety management systems for bodies providing audit and certification of systems"; ISO/TS 22004 "Food safety management systems"; ISO 22006 "Quality management systems".

The foreign experience shows that large volumes of rejected products during production require a lot of time (60%) for the corrective actions (Kusumano, 2016). We suggest applying the public support programmes targeted at the distribution and implementation of certified quality management systems at domestic companies in order to comply with HACCP standards following the practice adopted in foreign countries (Table 2).

Table 2. Number of certified quality management systems complying with HACCP system standards in foreign countries

Year	1993	2008	2009	2010	2011	2012	2013	2014
Africa	1009	8534	8435	7667	8164	9674	9856	10 123
Central and South America	140	37458	35549	49260	51685	51459	52478	55467
North America	2613	47896	41947	36632	37530	38586	48579	52678
Europe	37779	455303	500286	530039	459367	469739	485554	505547
Far East and Pacific region	4767	366491	408498	438477	471836	476106	467320	786331
Central and South Asia	74	44171	44432	37596	33577	32373	44847	46778
Middle East	189	20469	24604	18839	17069	19050	20812	21934
Total	46571	980322	1063751	1118510	1079228	1096987	1129446	1234567

* Compiled by the authors according to the data from (Goraczkowska, 2015; Kryvoruchko and Krukhmal, 2015; Osadciuk, 2015)

According to the results obtained in 2014, a significant amount of the certified quality management systems complying with HACCP system standards was registered in the European countries (53%), Far East and Pacific region (48%). These countries make up 88% of the system introduction level worldwide. There are certain data proving that this trend has been observed for many decades. The implementation of the system abroad shows a positive trend associated with their implementation by the companies. Therefore, it appears to be reasonable to use the experience of industrially developed countries in the development and implementation of quality management policy (Pahlova, 2015).

The generalization of experience associated with the domestic and the foreign quality management will enable to systematize the usefulness of Polli-Cook technique. The rationale for its application is as follows: this technique will enable to solve a number of important issues related to: analysis of the company operations taking into account specific factors of the foreign quality management experience; identification of the dependence of the fat-and-oil industry from the external and internal economic factors at the production life cycle stages; developing appropriate export/import policy; determining the organizational and economic quality management tools; management system implementation.

We think that Polli-Cook technique may be developed in the following direction: improvement of work coordination and increase in the labour productivity; setting up the goals for the company activity and orientation to satisfy continuously the needs; involvement of employees in the system development; determination of the product certification conditions. This will enable fat-and-oil companies to enter the markets of the industrially developed countries, which will ensure the increase in export volumes of the domestic products and the country national income.

4. Results

The following goals were set up taking into account the major research objective, i.e. management process improvement: identification of main issues of the industrial branch development; selection of a particular company to be the subject of analysis; establishment of an expert group to conduct expert assessment of a set of certain criteria; calculation of the weight coefficients; determination of expert opinion concordance level; the weighed estimation of every system structural component; calculation of integral index for the system development; adaptation of Polli-Cook technique to determine HACCP system life cycle phase (Ahmetova et al., 2015; Kozubikova and Zoubkova, 2016; Ob'yedineniye predpriyatiy po proizvodstvu I pererabotke rastitel'nykh masel i zhirov).

The quality improvement in the fat-and-oil industry is one of the most urgent problems in the Ukrainian industrial policy (Zybareva et al. 2016).

The statistical data for the period from 2015 to 2016 show that Ukraine had a leading position in the world market of sunflower-seed oil production and export that reached 4,200,000 tons. Cooperation with EU countries in product supplies is essential for the improvement of export relations and optimal combination of the interests of different countries, which is demonstrated by the increase in the sunflower-seed oil export volume by 30% compared to the period from 2013 to 2014, when the export share made up 13-17%. In the view of the current situation in Ukraine, which faces a decrease of sunflower-seed oil export prices and has stable procurement prices at the rate of 400 US dollars/ton of sunflower seeds, we may assume that this is a good start for the branch support and development (Ob'yedineniye predpriyatiy po proizvodstvu I pererabotke rastitel'nykh masel i zhirov).

In many respects, the index of consumer demand for fat-and-oil products depends on the price set by the manufacturer and purchasing power of the consumers. The results of the sunflower-seed oil consumption analysis are given in Figure 1.

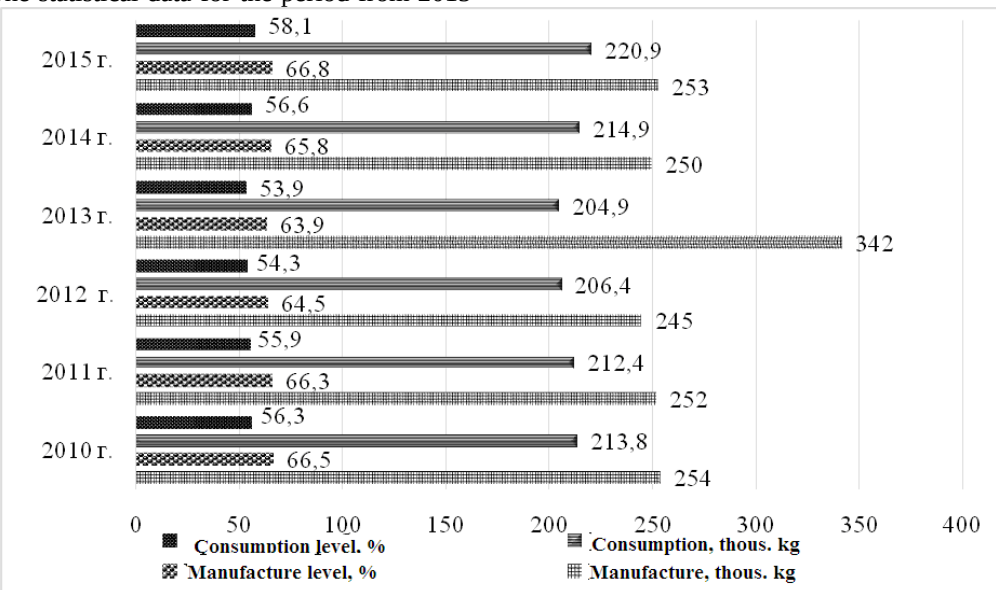

Figure 1. Dynamics of sunflower-seed oil production and consumption volumes per capita in Ukraine in 2010-2015, in kg

* Citation of the statistical data of the Statistics Service of Ukraine (Derjavna slujba statystyky Ucrainy)

Figure 1 shows that there is a positive trend towards the increase in industrial production indexes (from 66.6% to 66.8%) and consumption indexes (from 56.3% to 58.1%) for fat-and-oil products per capita in Ukraine over the period from 2010 to 2015. It is worth mentioning the period from 2010 to 2013, when the sunflower-seed oil consumption volume tended to reduce from 213 ths. kg to 205 ths. kg per capita. Within the period from 2014 to 2015 the production volume increased up to 253 ths. kg and consumption volume increased up to 221 ths. kg. The major problem faced nowadays is that the annual consumption rate, i.e. 380 ths. kg, is considerably higher than the estimated sunflower-seed oil consumption level in 2015, i.e. 221 ths. kg, as shown in Figure 1 (8).

For further analysis, we have taken a particular company, i.e. PJSC ChMK, which currently faces the problem of increased expenses due to the increase in the percentage of products rejected (Table 3).

Table 3. Dynamics of planned and actual parameters of sunflower-seed oil production in PJSC ChMK in 2015

Parameter	January	February	March	April	May	June	July	August	September	October	November	December	Total
Plan, pcs.	833	1000	1333	1833	2083	2500	2167	2000	1833	1667	1500	1250	20000
Actual, pcs.	531	615	1200	1315	2100	2310	2204	1910	2001	1529	1340	1235	18291
Deviation, (+,-)	-302	-385	-133	-518	17	-190	37	-90	168	-138	-160	-15	-1709
Plan performa-nce, %	63.7	61.5	90.0	71.7	100.8	92.4	101.7	95.5	109.1	91.7	89.3	98.8	91.5
Acceptable level of rejects, pcs.	14	20	35	66	85	122	92	78	66	54	44	31	706
Specific ratio of rejects, %	1.6	2.0	2.6	3.6	4.1	4.9	4.2	3.9	3.6	3.3	2.9	2.4	3.5

*Compiled by the author according to PJSC ChMK reporting data

Table 1 shows that the actual production parameters at the end of the year made up 18,291 pieces, while the target was 20,000 pieces, therefore, shortfall in production target was 1,709 pieces. The plan was fulfilled at 91.5%. The acceptable level of rejects at the end of the year was 706 pieces. The percentage of rejects tended to increase from 1.6% (in January) to 3.5% (in December), which affected the product quality. For the percentage of rejected products to be reduced, we suggest that both domestic and foreign scientists united their efforts to develop an integrated scientific approach, i.e. lean production" technique, using HACCP system (19, p. 117).

For the advancement of the world science, we defined a methodical approach based on the combination of both expert assessment and adapted Polli-Cook technique to identify the phases of the quality management system

life cycle that would enable to determine the stage of the system evolutionary development. This makes up a scientific novelty of the research and links the article and this research objective.

5. Discussion

For building the model of HACCP system life cycle, we suggested using the weighed estimates, obtained during the expert assessment, for basic structural components using "3 sigma rule".

1) The system is in its "development phase", if the integral index of quality management system (Iqms) is less than 40.00;
2) The system (its basic components) is in its "implementation phase", if Iqms values are within the range, ("μ" _k)¯ - 3 σ _ 1);
3) The system is its "evolution phase", if Iqms values are within the range (("μ" _k)¯ - 3 σ _ 1, (μ _k)¯);
4) The system is its "maturity phase", if basic Iqms values for its major components are within the range ((μ _k)¯, ("μ" _k)¯ + 3 σ _ 2);
5) The system is in its "establishment phase", if its Iqms values for its major components are within the range (("μ" _k)¯ + 3 σ _ 2; μkmax) (15; 24 p. 92).

The results were verified (Table 4) using the following formula 1(1).

$$W = \frac{12 \cdot S}{m^2 (n^3 - n)}; \quad (1)$$

Where,

W – concordance coefficient;

S – Sum of squared deviations;

m – Number of experts;

n – Number of factors.

Table 4. Results of expert assessment after HACCP system introduction

No. of estimate	Weight coefficient	Experts										Total score
		I	II	III	IV	V	VI	VII	VIII	IX	X	
Organization subsystem												485
1.1	0.22	7	8	7	9	10	8	9	10	8	8	84
1.2	0.14	8	8	7	9	8	9	8	7	10	8	82
1.3	0.14	9	10	8	8	7	8	8	10	10	8	86
1.4	0.18	8	8	7	10	10	8	7	9	8	8	83
1.5	0.14	8	7	8	6	5	5	8	9	5	5	66
1.6	0.18	10	7	8	7	7	8	9	10	8	10	84
Training of personnel												444
2.1	0.25	9	8	7	8	8	10	8	10	8	8	84
2.2	0.21	9	10	10	10	8	9	9	8	10	10	93
2.3	0.17	10	9	9	10	10	8	8	10	8	10	92
2.4	0.2	8	7	8	10	9	8	10	10	8	8	86
2.5	0.17	9	9	9	8	8	10	8	9	9	10	89
Quality management system documentation												354
3.1	0.3	8	10	9	8	10	7	10	10	9	10	88
3.2	0.27	8	7	9	8	8	10	10	9	10	10	80
3.3	0.23	8	8	8	9	10	10	9	8	10	10	88
3.4	0.2	9	9	7	8	10	8	8	8	7	10	79

Table 4. Results of expert assessment after HACCP system introduction (continued)

No. of estimate	Weight coefficient	Experts										Total score
		I	II	III	IV	V	VI	VII	VIII	IX	X	
Planning subsystem												448
4.1	0.18	9	8	10	9	9	10	8	8	10	10	91
4.2	0.25	8	7	9	8	8	10	9	9	10	10	88
4.3	0.18	8	9	9	8	10	10	8	8	9	9	88
4.4	0.19	9	8	8	10	7	9	10	8	10	10	89
4.5	0.2	10	8	9	9	10	9	9	8	10	10	92
Control subsystem												489
5.1	0.27	8	9	7	9	7	10	10	9	5	10	84
5.2	0.15	9	8	10	8	8	7	9	7	7	5	78
5.3	0.15	8	5	5	7	8	9	8	7	9	10	76
5.4	0.13	7	7	8	6	9	7	5	7	8	7	71
5.5	0.18	8	10	10	10	9	10	9	8	9	10	93
5.6	0.12	8	9	8	8	10	8	9	8	9	10	87
Motivation subsystem												439
6.1	90	9	8	9	9	9	8	9	9	10	10	70
6.2	88	8	8	10	9	7	9	8	9	10	10	81
6.3	89	8	8	9	8	10	8	10	8	10	10	64
6.4	90	10	9	10	8	9	10	9	7	8	10	56
6.5	82	9	9	7	9	8	8	8	7	9	8	53
Corporate culture												355
7.1	0.25	8	8	8	9	7	8	5	9	9	10	81
7.2	0.3	9	10	9	10	10	8	9	10	7	10	92
7.3	0.23	8	10	10	9	10	8	8	10	10	10	93
7.4	0.22	8	9	8	7	10	8	9	10	10	10	89
Supplier management												245
8.1	0.45	5	7	8	8	8	6	7	5	9	9	72
8.2	0.28	8	10	9	7	8	10	8	9	10	10	89
8.3	0.27	8	7	8	7	9	10	10	8	7	10	84
Production subsystem												449
9.1	0.25	8	7	8	8	9	7	8	10	8	9	82
9.2	0.25	8	10	10	9	8	10	9	7	9	10	90
9.3	0.27	8	10	9	10	10	9	8	10	10	10	94
9.4	0.12	9	10	9	7	10	8	9	8	10	9	89
9.5	0.11	10	8	10	8	9	10	10	10	9	10	94

The statistical significance of concordance coefficient may be calculated using $\chi 2$ test (formula 2) (20, p. 755):

$$x^2\text{pac} = m \times W(n-1); \quad (2)$$

$$W = \frac{12 \times 166\,167{,}4}{10^2(4\,3^3 - 43)} = 0{,}25;$$

The actual $\chi 2$ value obtained is compared with its critical value $\chi 2_{cr}$ (n-1; α). If the actual value exceeds the critical level, the concordance coefficient is considered to be reliable. There is rather high correlation dependence between the criteria:

$$x^2\text{pac} = 10 \times 0{,}25\ (43 - 1) = 105;$$
$$x^2\text{табл} = 58{,}1 \text{ при } a = 0{,}05.$$

$x^2\text{pac}$ value is greater than $x^2\text{табл}$, in this case the expert opinions regarding HACCP system assessment at PJSC ChMK are thought to be concordant. The estimated values of concordance coefficients were found to exceed the critical level, thus confirming the coordination of expert actions and reliability of the results.

After the significance of the results obtained was confirmed, we calculated the weighed estimates for the HACCP system basic structural components The system formation and development status at the company underwent an expert assessment in accordance with the approach offered to obtain its overall score (formula 3) (Pahlova, 2015, p. 97):

$$M_k = \sum_{j=1}^{n} W_j * S_j \quad (3)$$

Where,

Mk – Weighed estimate of the quality management system k-component;

Wj – Weight coefficient of j-criterion;

Sj – Sum of scores given by experts to j-criterion.

The following formula should be used to calculate the integral index to assess the progress of the quality management system formation (Ipqms) (Osadciuk, 2015, p. 118):

$$I = \sum_{k=1}^{p} M_k * W_k \quad (4)$$

Where,

Mk – Weighed estimate of the quality management system k-component;

Wk – Weight coefficient of the quality management system k-component.

The results of the weighted estimate calculations are given in Table 5.

Table 5. Assessment of HACCP system formation progress for each structural component at PJSC ChMK

Basic system components	Weight coefficient (Wk)	Weighted estimates of the system structural components (Mk)	Integral index to assess the system formation progress (Iqms)
Organization subsystem	0.12	81.3	9.76
Training of personnel	0.08	88.5	7.08
Quality management system documentation	0.17	88.83	15.1
Planning subsystem	0.14	89.53	12.53
Control subsystem	0.15	82.19	12.33
Motivation subsystem	0.06	88.5	5.31
Corporate culture	0.02	88.82	1.78
Supplier management	0.07	80	5.6
Production subsystem	0.19	89.4	16.99
Sum	1	777.07	86.48

*Compiled by the author on the basis of the expert assessment results

As shown in Table 5, the integral index value of the investigated quality management system exceeds the minimum set level (makes 86,48), thus demonstrating that HACCP system is not in the "development phase". The following subsystems got the greatest scores as per the weighed estimates of the system basic structural components: planning (89,53) production (89,4), corporate culture (88,82), quality management system documentation (88,83), training of personnel (88,5). These subsystems require further improvement through quality management system implementation. For this purpose, the system life cycle model should be built separately for each structural component to identify the progress of each component formation and development.

We suggest that Polli-Cook technique is used at the life cycle phases of the system implementation at PJSC ChMK (Figure 2).

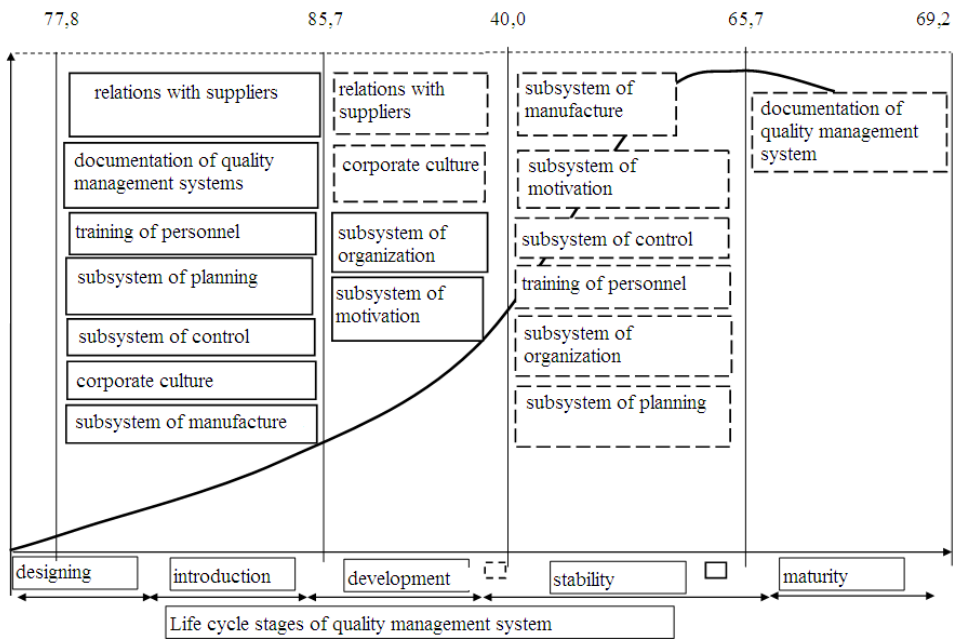

Figure 2. Life cycle model of HACCP system implementation at PJSC ChMK

As shown in Figure 2 the system built at the company is in the "implementation phase" that does not seem to adequate for the reduction of the growing percentage of rejects. In order to solve this issue, it is necessary to improve the performance of all subsystems, which are in "introduction", "development", "stability", and "maturity" phase (Zybareva, Iaskal, Bezrodna, 2016, p. 89-92).

According to the scientific concepts of the foreign authors, Khamidullina and Puryaev, the general status of the quality management system formation should be determined. As it was mentioned above, we suggest using their theory based on the assessment of its basic components, as this approach would enable to assess the status of the investigated system and to identify a group of criteria affecting its status. At the same time, it would be possible to determine a set of criteria, requiring further enhancement and development (2). Thus, the model used to assess the quality management system formation will be as follows:

$$QMSS = \{SO; SPT; SD; SP; SC; SM; CC; RS; SSM\} \quad (4)$$

Where,

QMSS – status of the quality management system formation; SO – status of the subsystem formation within the organization; SPT – status of the personnel training subsystem introduction; SD – status of the quality management system documentation; SP - status of the planning subsystem arrangement; SC – status of the control subsystem arrangement; SM – status of the motivation subsystem introduction; CC – status of the corporate culture subsystem development; RS – status of supplier management subsystem; SSM – status of production subsystem introduction. This model serves the basis for the determination of the integral index to be used to assess the system status, its calculation is shown in Table 5.

There are certain contradictions in the research theories of the foreign scientists, such as Khamidullina and Puryaev (2016), Goraczkowska (2015), Istomina and Fedorova (2014), Persky and Freiman (2014) and the domestic scientists, such as Osadciuk (2015), Zybareva and Iaskal (2016). The foreign scientists point out that for the rational implementation of business-process automation systems it is required to know both the areas, where the production losses occur, and product value. Though "lean manufacturing" concept is associated with the production, a number of its principles may be used for the introduction of effective business automation at non-manufacturing companies as well.

The domestic scientists focus on the necessity to solve the issues associated with the consumption of high-quality and safe food products in Ukraine, which require the introduction of quality management systems, rather than lean manufacturing principles. Though, the research results do not fully reflect the real situation in the post-socialist countries in general and, particularly, in Ukraine, as these countries require the development of a specific quality management policy (Alfiya and Aidar, 2016; Derjavna slujba statystyky Ucrainy). Therefore, we suggest using the research results obtained as the guidelines for Ukrainian companies to apply them in practice. The significance of the scientific research is demonstrated by the results of the foreign experience analysis, according to which the efficiency of the product quality management depends mostly on the measures used to introduce the quality management system.

6. Conclusions

The article contains essential conclusions and specific proposals that are capable to determine the economic trends and have practical and scientific significance for the economic development, namely, for the fat-and-oil industry development. This Ukrainian industry showed a positive trend towards the increase in the production indexes (from 66.6% to 66.8%) and the consumption indexes (from 56.3% to 58.1%) of fat-and-oil products per capita over the period from 2010 to 2015. The problem faced by the Ukrainian industry in 2015 is that the annual consumption rate, i.e. 380 ths. kg, is considerably higher than the estimated sunflower-seed oil consumption level, i.e. in 221 ths. kg.

In 2015 the production plan was fulfilled by PJSC ChMK at 91.5%. The acceptable level of rejects was 706 pieces at the end of the year. The percentage of rejects tended to increase from 1.6% (in January, at the beginning of the year) to 3.5% (in December, at the end of the year). All these problems necesitated the investigations in order to implement the system.

In 2014 the certified quality management systems complying with HACCP system standards were registered in the European countries (53%), Far East and Pacific region (48%), thus, the total level of quality management system implementation worldwide makes up approximately 88%. Therefore, we suggest using the experience

of the industrially developed countries in HACCP system implementation, as it ensures full and comprehensive product quality management in compliance with the international standards, particularly, IFS 2003; BRC 2008; ISO 22000:2005; ISO 22001; ISO / TS 22002; ISO / TS 22003; ISO / TS 22004; ISO 22006.

If the companies do not have any quality management systems, we suggest using the international standards regarding HACCP system, along with the domestic standards: DSTU ISO 9000:2007 (quality management system); DSTU ISO/IEC 17000:2007 (compliance estimation system); DSTU ISO 14050:2004 (ecological management system); DSTU-P ISO/TS 22003:2009 (food safety control system). The standards ensure the product quality improvement and advise the companies to introduce the certified systems.

The current situation and trends of the Ukrainian fat-and-oil industry development were reviewed. The analysis included both external and internal environmental factors. The particular company was taken for the review in order to determine the system functional performance. The company industrial and economic activity was subjected to the analysis. The percentage of rejects during sunflower-seed oil production was analysed. As a result, the decision was made to introduce the quality management system. The methodical approach based on the combination of both expert assessment and adapted Polli-Cook technique was developed to make up a scientific novelty of the research. The worldwide known Polli-Cook technique was demonstrated to be useful. The system development phase within its life cycle was determined based on this technique. HACCP system was applied at the domestic industrial facility. The major challenge associated with the company activity was identified, namely, detection of defective products at the manufacturing stage. The principles of the international standards, on which this system is based, were syhhested to be followed. The company operations underwent an expert review. The weight coefficients were calculated. The Expert opinions were found to be consistent. The basic quality management system components were analyzed. The integral index was calculated to determine the system status. The foreign experience was summed up to show how the public support programmes for the companies are used and implemented. The companies were suggested using the foreign experience to improve the quality.

In industrially developed countries implementation of the modern quality management systems is a mandatory legal requirement for many countries worldwide. Their effective implementation at the domestic companies would contribute to the manufacture of high-quality food products. Currently the compliance of products with the international standards may be reached, if the industry moves up to a certain new stage of development, including active system implementation. Implementation of this research results will ensure a greater enhancement of quality management systems. It will allow the development of expense-reducing activities via the reduction of percentage of defective products. It will contribute to further development targeted at new reserves for quality improvement. The main trends were identified to be used by the companies for the improvement of their business based on the world experience.

No human, niether animal trials were conducted, since they were prohibited by Mr. Fesyuk VM, CEO, PJSC ChMK. The research was performed by the authorized individuals after it was approved.

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representative, Cholkan VM, director of the joint venture, LAVA-UKRAINA, on the other hand, draew up this certificate and agreed that the " Contractor" would conduct the research targeted at the analysis of product quality management improvement at public catering facilities, taking into account current trends in the management science and management practice in the conditions of financial and economic crisis. The work was performed fully and at the high quality. The "Customer" has no claims to the "Contractor" regarding the quality and work scope. The financing sum made up 1000 hryvnyas. We would like to express our sincere gratitude for the financial assistance in this research.

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