
The Deming Cycle (PDCA) Concept as a Tool for the Transition to the Innovative Path of the Continuous Quality Improvement in Production Processes of the Agro-Industrial Sector

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Abstract:

The agricultural production and agro-industrial sector are two major industries, the performance of which has an impact on the living standard of the population in different countries. The high quality of production in the agro-industrial sector determines both the availability of food for the population and the food security of the country. Taking into account that the most developed countries and countries with the transitive economy have already overcome the problem of food deficiency, and that still this problem exists in developing countries, this article suggests using a traditional tool for the quality management (Deming Cycle or PDCA), complemented by a strategically oriented approach. The main findings of the article are as follows:

- *Firstly, the problem of food sufficiency is solved in the global economy in a different way; the majority of population in developing countries does not have access to good quality food. This has a negative impact on their vital activities, as well as on the overall socio-economic development of such countries;*
- *Secondly, the use of complicated management tools for steadily improvement of the production quality in the agro-industrial sector of developing countries is not always feasible from scientific and practical points of view. The complication of the tools does not involve the solution of the problem;*
- *Thirdly, a traditional quality management tool, known as the Deming Cycle or PDCA, has a significant potential for use even now. This article provides a strategic approach to the use of the Deming Cycle (PDCA) to solve the problem of deficiency and low availability of good quality food supplies in developing countries.*

Key Words: *Deming Cycle, quality management, PDCA, food security, famine elimination, strategy, agro-industrial sector.*

JEL Classification: *O10, O31, O32, Q13*

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Introduction

At the present stage, the catastrophic and apocalyptic scenarios of the civilization development after the active introduction of scientific discoveries at the beginning of the 21st century (shale revolution in the USA, the rapid development of genetic engineering technology in the West and in China, the active development of “green energy” in the world, etc.) have proved to be ineffective. Thus, there is a need for the qualitative review of future scenarios of the development of the modern civilization in general and individual regions, ecumenes in particular (Walliser, 2008). This refers both to the highly developed civilizational habitats and to the regions, which are traditionally considered to be underdeveloped (Dinur, 2011; Norse, 2012).

Many of the abovementioned scientific concepts were developed in the early – mid-twentieth century, but it was not until fairly recently that their commercial implementation became possible (at the end of the last century and at the beginning of this century). Therefore, along with a number of social, technological, economic and political achievements, the key issues of providing the world's population with good quality food resources remain highly relevant.

That is why the international non-governmental organizations, institutional and venture capital investors, governments of the countries pay considerable attention to the development of the agro-industrial sector, which makes a significant contribution to the formation of human capital and intellectual potential of the world's population (Mathe, 2013; Sekhampu, 2013; Ziatdinov and Tyunnikov, 2016).

At the same time, the development of technology, an increase in the availability of bank lending and the expansion of access of underdeveloped countries to high technology in the agro-industrial sector (mainly with the active participation of Western and Chinese transnational corporations) significantly negate the importance of the highly productive land and its areas (as a key factor of agricultural production) against the world indicator. In previous studies (Dudin *et al.*, 2016; 2015) we have repeatedly shown that the availability of fertile land is one of the aspects; its effective and intensive use is possible only by means of the management of production processes in the agro-industrial sector on the basis of key quality management concepts.

The production quality management in the agro-industrial sector involves not only the formation of competitive advantages, it is also a social responsibility of manufacturers, which, in combination with the environmental responsibility, forms a new understanding in developing business models that are more focused on the achievement of parity between the needs of society and the needs of entrepreneurs. In turn, this means the growth of quality and living standards, which is also achieved

by increasing economic and physical access to food resources (Firescu and Popescu, 2015; Havlíček *et al.*, 2013; Kovalenko *et al.*, 2016; Tyaglov *et al.*, 2017).

We suppose that the product and service quality management in the agro-industrial sector is currently one of the few practice-oriented tools, the effectiveness of which has been proved by time and demand patterns. This thesis is also confirmed by the results of previous studies (in particular, the analysis of trends in the agro-industrial sector development in Italy, as well as the applicability of the concept of “business model canvas” for Russian agricultural and agro-industrial enterprises (Dudin *et al.*, 2015a; Osterwalder and Pigneur, 2010; Clark *et al.*, 2012; Frank *et al.*, 2016; Bashmakov *et al.*, 2015) and the statistical data (Food and Agriculture Organization of the United Nations, 2013; Food and Agriculture Organization of the United Nations, 2015) which provide an additional scientific value to the cycle of proposed publications.

Therefore, we offer to comprehensively and systematically consider the problems of quality assurance in the agro-industrial sector, including with the involvement of recommended quality management tools. The Deming Cycle (Sidhu *et al.*, 2013; Walton, 1988), being one of such tools, allows combining seemingly conflicting aspects: the simplicity of the algorithm, which can be used in the management of the quality of production processes of the agro-industrial sector, as well as the effectiveness of management practices.

It is also worth mentioning that the willingness to conduct the optimization very often forces manufacturers to explore, as well as the scientists to justify complex algorithms of developing and making decisions, the analysis of production processes. This leads to the fact that a complex tool trigonometric set, not econometrics and economic-mathematical modeling, is used for addressing managerial tasks. Such scientific and practical approach is mainly not justified and involves more threats and risks than benefits. To control the quality of production and service processes in the agro-industrial sector it is more rational to initially use the most simple, but at the same time the most efficient algorithms and to complicate them only when necessary.

Firstly, such understanding of the scientific approach allows solving the existing problem of the weak interrelation of Russian business and Russian science. Secondly, in the current conditions of geopolitical instability (Brexit, D. Trump’s victory in US elections with ambiguous consequences, Islamist and nationalist threat) a rational scientific approach will establish a strategic reserve for the Russian economy and also create incentives for the advanced development of the national agro-industrial sector, which is important for the import-oriented economy adopted by the Russian government.

It should be understood that a theoretical-methodological and practical concept known as the Deming Cycle (Plan-Do-Check-Act or PDCA) has a deep scientific and historical basis and, in particular, it uses an inductive method, based on the rational analysis of experimental data, which was proposed by Francis Bacon in the 17th century. In addition, a scientific concept called the Deming Cycle is largely focused on the study of traditional and comprehensible indicators. The population size is one of these traditionally significant indicators. It is well known that at the moment the concentration of the world population is disproportionately high in underdeveloped and developing countries.

This manifests both in spontaneous demonstrations of the population, including those caused by a decrease in the availability of critical life resources (especially food products) and in uncontrolled migration flows mainly along the line "Arab-Muslim world – Western Europe" (Walliser, 2008; Dinur, 2011; Norse, 2012; Mathe, 2013; Sekhampu, 2013; Ziatdinov and Tyunnikov, 2016; Dudin *et al.*, 2016; Dudin *et al.*, 2015; Ovchinnikov *et al.*, 2015). That is why an effective quality management in the agro-industrial sector is an essential economic and social problem, the solution of which guarantees the geo-political and socio-political stability.

Methods

In this article, when presenting the study results, a set of general and specific scientific methods (content analysis, synthesis, induction, deduction, economic-statistical and geo-economic analysis) have been used. The authors suggest investigating and comparing the benefits and costs of the use of various traditional quality management tools that can be used in the agro-industrial sector.

The most famous traditional quality management tools (in addition to the Deming Cycle) are as follows: Pareto chart, Ishikawa diagram, histogram, checklist (Walton, 1988; Goetsch and Davis, 2013; Johnson, 2002). Table 1 presents a comparative analysis of quality management tools, which can be used in the agro-industrial sector.

Table 1. Comparative analysis of traditional quality management tools [drawn up by the authors]

Tools	Benefits and problems of use in the agro-industrial sector	
	Benefits of use	Problems of use
Deming Cycle (PDCA)	It allows clearly structuring the production processes at the main stages	It requires the submission of the results of the analysis and assessment in a formalized linear form
Pareto chart (Pareto curve)	Simplicity and clarity allow using tools by a wide range of	In the construction of a complex, not enough clearly structured chart

	employees	incorrect conclusions are possible
Ishikawa diagram (Cause-and-Effect-Diagram)	It allows establishing cause-and-effect relationships between the factors affecting the quality and results obtained	The tool does not allow investigating the interaction of causes and their effect (as factors) on the result for a fairly long period of time
Histograms	Visibility and simplicity of adoption and use	When using a small sample, a histogram can give wrong conclusions
Checklist	Visibility and simplicity of use	A large number of different options and forms of checklists reduce the effectiveness of the use of the tool

Obviously, the Ishikawa diagram is the main competitor of the Deming Cycle (PDCA) concept (in terms of objectivity, reliability and use of the inductive methodological approach to the study of factors affecting the quality). But, at the same time, it is worth noting that the weaknesses of the Ishikawa diagram are weightier than existing advantages and benefits of use. Therefore, the authors consider the Deming Cycle concept as the most rational concept in terms of quality management and control (the quality of products, processes, services) in the agro-industrial sector.

Results

The quality of production of products, organization of activities and provision of services in the agro-industrial sector determines the quality of social life. Available statistic data clearly show that there is a direct relation between the standard of living, the quality of production resources and their availability to the public. The reports published by the Food and Agriculture Organization of the UN in the period from 2012 to 2015 show that the higher the income level, the higher the quality and availability of food resources (Table 2).

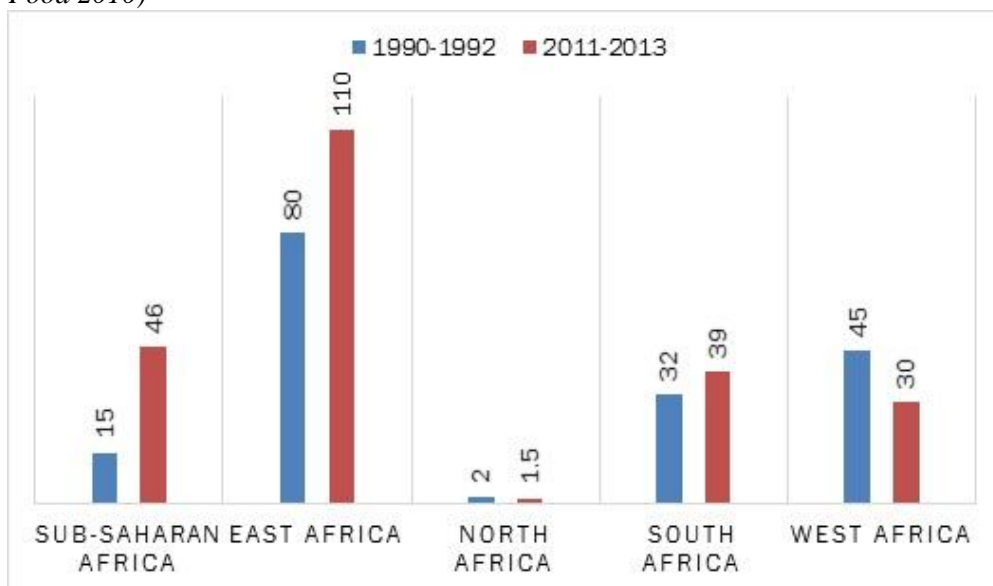
Table 2. Comparison of world regions as for the standard of living and availability of good quality food resources (for the period from 2012 to 2015 inclusive) (Food and Agriculture Organization of the United Nations - 2013, 2015; Directorate-General for Research and Innovation Biotechnologies, Agriculture, Food 2010)

World region	Income level per capita	Dietary energy consumption (kcal per person per day)
Developed countries (OECD countries)	From 21 to 33 thousand US dollars	From 3.2 to 3.4 thousand kcal
Asian countries not included in OECD or in a group of developing countries	From 2.5 to 7.5 thousand US dollars	From 2.45 to 2.8 thousand kcal

North African countries	From 5 to 11 thousand US dollars	From 3.1 to 3.3 thousand kcal
Developing countries	From 5.4 to 10.8 thousand US dollars	From 2.5 to 2.8 thousand kcal
Latin America and Caribbean countries	From 7.1 to 11.5 thousand US dollars	From 2.65 to 2.9 thousand kcal
Sub-Saharan Africa	From 1.9 to 3.1 thousand US dollars	From 2.2 to 2.35 thousand kcal

Sub-Saharan Africa and Asian countries not included in the OECD or in a group of developing countries are the closest to the boundary values with normal daily consumption from 2 to 3 thousand kcal per day. In these regions, the standard of living is very low. This causes the growth of the population, who do not have access to good quality food resources. For example, as for the entire African continent, it may be noted that in Central, Eastern and Southern Africa the number of people suffering from malnutrition has increased very significantly, while in North and West Africa the number of such population tends to decrease (see Figure 1).

Figure 1. The number of African population suffering from malnutrition, mln. people (Food and Agriculture Organization of the United Nations - 2013, 2015; Directorate-General for Research and Innovation Biotechnologies, Agriculture, Food 2010)



If we consider the European region, it may be noted that the problem of hunger has been successfully solved here; on the other hand, there is overproduction of food products in the European region, which creates environmental problems and gives rise to new forms of consumer behavior (e.g. freeganism). Much of the excess food resources accumulating in European countries are a natural consequence of the policy to promote the quality of the organization of agro-industrial activities and the quality of manufactured products in the agro-industrial sector (Directorate-General for Research and Innovation Biotechnologies, Agriculture, Food, 2010; Anikina *et al.*, 2016). It is obvious that the solution of the food problem in countries, where there is low economic and physical accessibility of good quality food products, can be found by using the Deming Cycle concept.

Discussion

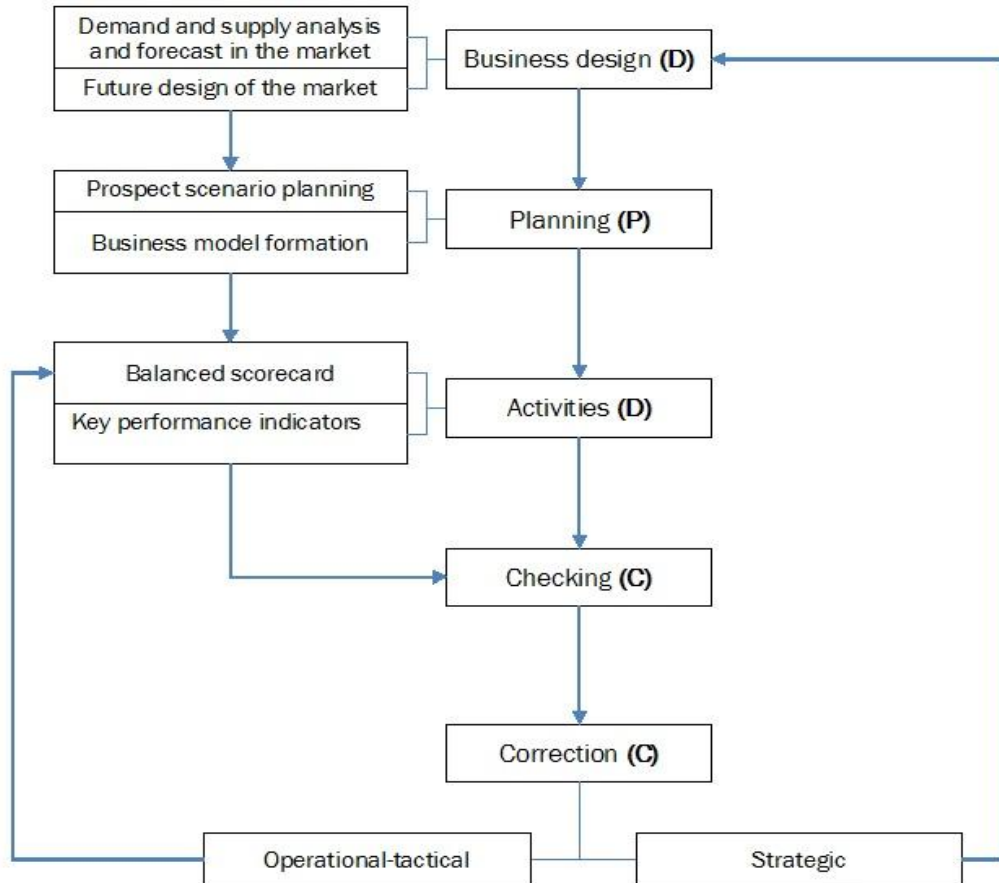
With all its apparent simplicity, the Deming Cycle is a powerful and effective quality management tool. The Deming Cycle idea is that at each subsequent stage solutions and actions implemented at the previous stage create certain benefits and mitigate threats. For the agro-industrial sector, this approach to the quality management is of particular social relevance and, at the same time, the Deming Cycle can be used as an integrative solution in the context of the combination of direct and ongoing scientific advances with a view to develop the most optimal practice-oriented concepts allowing to achieve the goals set.

Moreover, the use of the Deming Cycle is of particular relevance in the agro-industrial sector (Sidhu *et al.*, 2013; Johnson. 2002) of the countries characterized by the low food security, and this is due to the fact that in these countries the overall level of management sciences cannot be considered sufficient, which, in turn, means that the solutions, which are relatively simple and understandable for a broad range of employees, will be the most in-demand.

It should also be noted that the Deming Cycle is a traditional management tool, which was created under predictable economic and other processes. Currently, this tool must be supplemented by modern management techniques, one of which is business design.

Business design is a simplified representation of rather complicated procedures of foresight planning and road mapping. Business design is a set of analytical and forecasting procedures, which are focused on the description of the concept of the development of the entrepreneurial initiative onto a certain (usually medium-term) prospect. Accordingly, business design is the first step or the first phase of the Deming Cycle, which should be considered under the following amended scheme (Figure 2).

Figure 2. A strategically oriented Deming Cycle concept proposed to improve the quality of products, processes and services in the agro-industrial sector



It should also be noted that Figure 2 represents a strategically oriented scheme of the Deming Cycle, because at the level of operational-tactical planning there is no point in repeated conduct of the analysis and forecast of the market demand and supply. Accordingly, planning is preceded by a phase or stage of business design in the strategically oriented scheme. In the agro-industrial sector, the stage of business design involves the solution of the following tasks:

Firstly, to analyze or forecast the demand and supply on agricultural and food markets. The demand should be viewed in the context of the hedonistic, ascetic and mixed model of consumption. In turn, the supply should be viewed in the context of the traditional, innovative and organic agricultural production;

Secondly, to formulate the most reliable image concept (future concepts) of agricultural and food markets. It is advisable to consider a traditionalist, modernist and integrative concept of the future of agricultural and food markets.

After that, it is advisable to proceed with the planning of economic activity. At the same time, it is important to plan and simulate business development in the agro-industrial sector in order to form the most adequate plans, and the data collected at the stage of business design should be taken into account. A formalized strategic plan is the basis for the development of current plans and guidance on the operations management.

To monitor the effectiveness of management at the planning stage the balanced scorecard is formed, under which key performance indicators (KPI) are defined (Rompho, 2011; Kaplan and Norton, 2006), taking into account the requirements for the product quality and formation of business processes. These control data are used for taking further actions and making adjustments to strategic and operational-tactical plans. Thus, the Deming Cycle has a significant strategic potential for use in order to ensure the quality of products, processes and services in the agro-industrial sector of both developed and developing countries.

Conclusions

The current situation in the global agro-industrial sector is characterized by duality. On the one hand, there is an increase in volumes of the production of agricultural and food products in the most developed countries and the countries with transitive economy. In due time, this allowed overcoming hunger and poverty, thereby increasing the level and standard of living of the population, who have received a normal access to food resources.

On the other hand, in the least developed countries a problem of hunger remains, which is associated with the general socio-economic backwardness of these countries in general and in the agro-industrial sector of these countries in particular. The limitation of the least developed countries' access to good quality food supply leads to long-term negative macroeconomic effects (reduced labor and entrepreneurial potential, the weak development of the scientific and technical sector, the growth of the national burden of diseases, etc.).

Therefore, in order to enhance the functioning of the agro-industrial sector and solve the food problem in the least developed countries it is proposed to use advanced tools in the form of a strategically oriented Deming Cycle, the main purpose of which is to improve the quality of agricultural and food products, optimize the structure of business processes and the organization of services.

In this article, we have not considered such important methodological and practical aspects as key agro-industrial sector trends, the supply and demand models (their determinants), the processes of formation of the balanced scorecard system and approaches to the definition of key performance indicators (KPI). The authors plan

to consider these issues in the following publications on the management of the production quality in the agro-industrial sector.

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