

CALCULATION AND ANALYSIS IN THE EFFICIENCY OF APPLYING THE QUALITY MANAGEMENT SYSTEMS WITHIN INDUSTRIAL ORGANIZATIONS

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Abstract: - In this article we propose to illustrate the methodology of measuring and assessing the impact of quality systems on the performance of industrial businesses. If in terms of the total quality management system – TQM, the impact may be measured by comparing the business performance with a reference standard (for instance ISO 9001), which records the difference compared to the performance prior to implementing the TQM, or, on rarer occasions, by optimizing the costs of quality with the help of econometric models, for the integrated quality improvement system, comprising of the TQM system based on the ISO standards and the Kaizen management system, which we propose and assess within this article, the efficiency/performance will be measured through a methodology based on analyzing the evolution of financial indicators for business performance. This approach was implemented as a result of findings from the businesses where we have been provided with documentation, and where the calculation and assessment of quality system operation efficiency by optimizing costs using the classic or improved econometric models is not approved by the management.

Key words: - quality management, quality system, efficiency, improvement, method

JEL (Journal of Economic Literature) classification: O1, O2

1. Introduction

In addressing the topic of this article, we began from the finding according to which only the businesses which provide the market with products and services executed in a manner corresponding with the beneficiary requirements in terms of quality, materialized in a significant increment of competitiveness regarding the competitor supply, can survive in the current economy, under the influence of evolutions such as the globalization of markets, the customization of demand, the adaptation of Romanian economy to EU requirements, the increase in competitiveness between businesses and in the interest for protecting the natural environment.

The concerns regarding quality assurance have also increased in the Romanian economy along with our country's EU integration. This is due to the fact that the quality approach on a pan-European scale is based on the objective of creating a single market and the free movement of goods, which is only possible through the presence of two common features thereof, to ensure interconnectivity and to facilitate real competition. The quality management system adopted by all countries in the European economic space fills this role, with the quality promotion policy representing the underlying component of the European industry development policy.

In the same train of thought, one may observe that quality has currently become a strategic instrument for the EU economic policy, and the quality requirements have increased significantly; one believes that satisfying the client is no longer enough, his expectations must be exceeded by promoting the “Beyond Customer Satisfaction” concept, according to which the product provided must exceed client expectations, must thrill. As

a result, the Romanian businesses, as participants in the European and world transfer of assets, have also begun to implement major changes in the development strategy and policies, in order to provide highly competitive products and services, which would facilitate an advantageous market position compared to the competition). In this regard, one may observe that numerous companies on the Romanian market undergo an accelerated process of organizational and management transformations, in order to redefine their place and role on the market and to improve the supply. The implementation of quality management systems plays an essential role within this process. Therefore, at the end of 2013, 24,231 companies were certified according to the ISO 9001 standard for all activity sectors. However, there are still many companies which conduct predominantly stereotypical activities, without implementing an aggressive strategy that would allow them to obtain a high profit in order to reinvest in modernization, restructuring and quality improvement projects, so as to ensure a better position on the market. A comparative analysis conducted in this regard shows that the number of certifications in the quality management system in our country is low compared to most EU countries (Table 1).

The main cause for this situation is a lack of trust for many economic agents in the efficiency of applying the quality systems. The discussions held with the managers of some of the businesses documented led to the conclusions that such managers believe the implementation of quality systems as an expense not covered by the results, and the increase in quality as an action which determines the reduction of work productivity and an unjustified increase of expenses. This misconception may be explained by the practice of economic agents where reservations regarding the calculation of quality system efficiency occurs, justified by the fact that they are unable to keep correct tabs on quality costs and the effects thereof. The highlighting of quality costs in the documents (accounting documents), as observed in the practice of companies documented, indeed poses special problems generated by the fact that the accountancy of most business does not feature any accounts for the distinct registering of the two information categories (quality system costs and effects). Difficulties occurred when trying to precisely establish the quality costs are determined both by the methods used by companies for the calculation, planning and tracing of costs, as well as by a series of factors independent from accountancy systems, such as: certain quality costs cannot be quantified or their estimation is subjective: there is a discrepancy between the time of occurrence and the time of identifying deficiencies, as well as between the time of preventive measures and the time of obtaining the effects of such measures; the lack of management involvement; the high necessity of resources for implementing the system, etc. Furthermore, one of the issues posed by the highlighting (registering) of quality costs in the current economic practice, and one which we deem essential, is determined by the impossibility of precisely establishing the indirect expenses for quality assurance, expenses representing the largest percentage of quality costs. On example in this regard is represented by the investment projects for the technical modernization of the business. It is obvious, for example, that by purchasing certain installations, modern technologies the level of product execution precision, and implicitly, the quality of such products is increased. However, the amount of investment associated with this effect cannot be precisely determined. Another aspect we must consider in highlighting and determining quality costs is to take into account and quantify all the cost categories, including the so called “external costs”, respectively the expenses for environmental protection and those incurred by the company for obtaining and providing a certain level of quality. Therefore, a holistic approach is needed to define and select quality costs.

Table no. 1 – *The evolution of the number of certifications in the quality system for certain European countries*

<i>Number of ISO 9001 certifications</i>						
<i>Country / Year</i>	<i>2008</i>	<i>2009</i>	<i>2010</i>	<i>2011</i>	<i>2012</i>	<i>2013</i>
Romania	10737	15865	16200	19405	21641	24231
Poland	10965	12707	12195	10984	-	-
Germany	48324	47156	50583	49540	-	-
France	23837	23065	29713	29215	-	-
Spain	68730	59576	59854	53057	-	-
United Kingdom	41150	41193	44849	43564	-	-
Total number	455303	500286	530039	492248	-	-

* Information source: *The ISO Survey of Management System Standard Certifications 2013*

As a result, the calculation of quality system efficiency, which implies determining the ratio between costs and effects, cannot be performed. In order to solve this issue, a solution underlying the evolution of the process of quality system implementation within companies, we set out to showcase a methodology with which to measure the efficiency of implementation and operation of quality systems within industrial businesses, without the necessity of an extremely precise determination of quality costs, a methodology tested in a case study within this article.

2. Presentation of the Methodology for Calculating and Analyzing the Efficiency of Quality Systems Based on the Evolution of the Financial Indicators of the Business

2.1 Characterization of the Study Method

The research for finalizing the methodology was aimed at the impact of the integrated system (TQM) comprising of the ISO 9001:2008, ISO 14001:2005 and ISO 50000:2011 standards, combined with several methods from the Kaizen system, on the financial performance of S.C. ARCTIC S.A. The study also benefited from our documentation conducted for other business in the manufacturing industry (*ASSA ABLOY, Cris-Tim, Pirelli din Slatina, Eldon România, Star Transmission Cugir etc.*), a fact which led us to believe that its results may be generalized for the entire manufacturing industry.

The study is based on a comprehensive research which combines questionnaire-based research, in order to identify and select a sample of companies who have implemented the quality system, with an empirical analysis of financial data collected from such businesses and the direct examination of the financial data publically disclosed by the same. The basic concept used in this research adapts the study methodology to the *insider* model, so as to separate the impact of the quality system from those of other measures applied by the company. Furthermore, we also considered a feature common to all researched businesses – that according to which both the studied event, as well as the time of its occurrence may be precisely defined without impediment (for example, obtaining a quality certificate). I have made this statement because there are numerous cases when establishing the exact trigger of a researched event is extremely difficult when the reliability of the business is poor and you cannot trust the public statements made by its representatives. In this regard, the concrete economic situation shows that several organizations claim to have implemented the quality system, measure confirmed by ownership of the quality certificate, when, in fact, they have made no essential changes leading to results that can be attributed to the quality system. Obviously, the use of such unreal information made publicly available by the company that has implemented the quality system will lead, in the study, to results lacking any practical use. In order to avoid such a situation, the methodology used by us was completed by interviews with quality managers within the companies documented. We believe that the use of such interviews to gather information sought from the company has been the difference between our study and the typical questionnaire-based studies.

2.2 Choosing the Indicators for Measuring the Economic Efficiency of Quality Systems Implemented within Romanian Businesses

The main objective of implementing a quality management system is to increase the company's performance. In general, performance is associated with two key processes – management and measuring of performance. Performance measuring occurs as a sub-process of performance management, which mainly focuses on identifying, tracing and communicating performance results by using performance indicators. More precisely, after establishing the objectives desired by applying the decision intended to increase performance (in our case – implementing the chosen quality system), we require indicators which can measure progress separately. In this regard, the use of key performance indicators – KPI is recommended, indicators which can help quantify the achievements of the quality system, respectively the level of objective fulfillment. As a result,

such an indicator-based system may be used as a sole instrument for consolidating the managerial decisions to implement quality systems.

The quality of results in applying the system is associated with the selection of performance indicators. The most frequently used performance indicators are financial and they vary depending on the activity carried out and on the company function (production, human resources, commercial, financial, etc.). Moreover, it is necessary that the indicators selected be anchored in the dynamics and typology of the respective company, so that they may faithfully illustrate company objectives up to the last level.

Economic efficiency, determined with the help of financial performance indicators illustrates, in the context of features of the *insider* model, the very result of implementing the quality system, highlighted through the continuous improvement of products, processes, activities and the adequate involvement of employees motivated depending on the level of objective fulfillment, as well as satisfying a corresponding number of clients with the business' capacities and meeting environmental protection objectives.

For a useful analysis, suggestive in expressing the objectives followed in the case study, presented herein, we have provided a careful selection of key performance indicators, by choosing those which provide the competitive advantages generated by the quality system, are directly connected to performance, are measurable and ensure compatibility with various references. Thus, in order to distinctly highlight the contribution of implementing and operating the quality management system in improving the economic and financial results of the company assessed, the following indicators were used: Turnover (CA), Variable expenses, Margin over variable expenses (MCV), Fixed expenses, Operational profit, Break-even (PR), Return on investment (T), Economic rate of return on investment (RRE), Discounted net revenue (VNA), and Economic performance (R).

3. Applying the Proposed Method for Assessing the Efficiency of the Quality Management System within S.C. ARCTIC S.A.

The ARCTIC S.A. trade company manufactures electronic and household products with a high technical level, used for household needs (refrigerators, washing machine, vacuums, etc.). It has 2500 employees and a turnover, for 2014, of 384 mil. EUR. Arctic is present on the Romanian market through the Arctic and Beko brands, with a market share of approximately 35% and is a major exporter. Currently, 90% of the refrigerator appliances is exported to 59 countries throughout Europe, Africa and Asia. In July 2015, Arctic celebrated the production of the 25th million refrigerator since its establishment. In order to ensure a growing outlet demand, the company decided to make a 24 million EUR investment. Thanks to this project, the company will record a rapid increase of its turnover.

The company has implemented an integrated management system in two stages: in 2005 it has implemented an integrated system comprising of ISO 9001 and ISO 14001, while starting with January 2012, it has also implemented the ISO 50001:2011 standard, being a large electricity consumer.

By implementing the three standards in an integrated quality system, the company complied with the requirements imposed by the beneficiaries and by the companies with which it collaborates, the aim of the objective being to reduce the possibility of error occurrence to a minimum and to achieve the *zero faults* principle. Along with this integrated quality system, the company also implemented in 2013 methods corresponding to the continuous quality improvement management system – Kaizen. Therefore, the 6 Sigma, Total Productive Maintenance and Just in Time methods were integrated. As demonstrated below, the implementation of the quality management system had a considerable impact on the increase in company efficiency. Moreover, its consequences were obvious even during the crisis between 2009 and 2010 *when the company did not suffer*.

In order to demonstrate the efficiency of implementing and operating quality systems within industrial organizations, we must first assess the impact of implementing the total quality integrated system (TQM), comprising of the three aforementioned standards, during the 2005 – 2010 period, and of the impact generated by the combined action of the integrated system (TQM) and of the methods associated with the Kaizen management system during the 2010 – 2014 period.

For 2005, the simplified situation of the profit and loss account is showcased in Table no. 2.

Table no. 2 – The Balance Sheet of S.C. ARCTIC S.A. upon 31.12.2005

Indicator	Amount		Percentage from CA (%)
	Thousand EUR	Thousand lei	
Turnover	190000	836000	100
Variable expenses	114750	504900	60,0
Margin over variable expenses (MCV)	75250	331100	40,0
Fixed expenses	66500	300168	36,0
Operational profit	7030	567789	3,7

With the help of these values, the break-even may be determined according to the relation:

$$PR = \frac{CF}{MCV} \times 100$$

Where: PR – break-even; CF – fixed expenses; CV – variable expenses; MCV – margin over variable expenses.

Thus determined, the break-even illustrates the minimum percentage of activity in relation to production capacity, for which profit is nil. Results show that the break-even for the ARCTIC SA trade company amounts to 88.3 %, while in absolute values, it amounts to 166,250 thousand EUR, respectively 731,500 thousand lei.

$$PR = \frac{66500}{75250} \times 100 = 88.3 \% \text{ of production capacity.}$$

If we were to use the margin over variable expenses, determined as a percentage of turnover, we would obtain the break-even of values, respectively the minimum value of turnover for which the profit is nil. The calculation formula is:

$$PR = \frac{CF}{MCV\%}$$

$$PR = \frac{66500}{40\%} = 166,250 \text{ thousand EUR, respectively } 731,500 \text{ thousand lei.}$$

In the same, year the total costs of non-quality, represented by the cost of internal and external faults, rising to 28,000 thousand EUR, the equivalent of 15% of the turnover, were quantified. This means that the effective variable costs only actually amount to $75,250 \times (100 - 15) = 63,963$ thousand EUR, while the difference, amounting to 11,287 thousand EUR, represents non-quality costs.

The successful introduction of the quality management system represented a considerable improvement of indicators, fact noticeable by analyzing the simplified form of the profit and loss account for 2010 (Table 3).

As can be observed, the turnover reached the amount of 253 mil. The stabilization of the manufacturing process has determined a decrease in fault costs, which translated into a profit increase of 85% compared to 2005.

Table no. 3 – The Balance Sheet of S.C. ARCTIC S.A. upon 31.12.2010

Indicator	Amount		Percentage from CA (%)
	Thousand EUR	Thousand lei	
Turnover	253000	1113200	100%
Variable expenses	153000	673200	60,5
Margin over variable expenses (MCV)	100000	440000	39,5%
Fixed expenses	90330	397452	35,7%

Operational profit	12905	56782	5,1%
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Results show that for the ARCTIC S.A. trade company, the break-even for 2010 amounts to 90.3 %, while in absolute values, it amounts to 225,825 thousand EUR, respectively 993,634 thousand lei.

$$PR = \frac{90330}{100000} \times 100 = 90,3 \% \text{ of production capacity.}$$

The fact that the PR is greater than in 2005 is explained by the rapid increase of turnover. Moreover, this situation also resulted from the decision to invest in order to increase the production capacity for which, as shown, investments of 24 million EUR were allocated.

The result of the absolute value is:

$$PR = \frac{90330}{39,5\%} = 228,683.5 \text{ € respectively } 1,006,207.4 \text{ thousand lei.}$$

In the same, year the total costs of non-quality, represented by the cost of internal and external faults, amounting to 23,276 thousand EUR, the equivalent of 9.2% of the turnover, were quantified. This means that the effective variable costs only actually amount to $100,000 \times (100 - 9.2) = 90,800$ thousand EUR, while the difference, amounting to 9,200 thousand EUR, represents non-quality costs.

With regards to the inclusion in the time frame associated with the analysis, of the 2009 and 2010, the years of the financial and economic crisis, we must state that such has not influenced the results of the study, as the company suffered no significant consequences, and the financial indicators were on the rise during such period. Therefore, CA increased by 133%, while profit increased by 183%.

The successful introduction of the TQM quality management system and of the continuous quality improvement system – Kaizen, practically meant a step closer to achieving the *zero faults* objective, *as can be seen* in Table 4, where the simplified situation of the profit and loss account for 2014 is showcased.

As shown in the table, the turnover reached the value of 384,000 thousand EUR, representing an increase of 152%. The stabilization of the manufacturing process determined a decrease of defect costs, translated into a profit increase 1.5 times greater than in 2010. This means that a decrease of 9.2% for fault costs has determined a profit increase by approximately 50%.

For 2014, the simplified situation of the profit and loss account is showcased in Table 4.

Table no. 4 – The Balance Sheet of S.C. ARCTIC S.A. upon 31.12.2014

Indicator	Amount		Percentage from CA (%)
	Thousand EUR	Thousand lei	
Turnover	384000	1689600	100%
Variable expenses	230400	1013760	60%
Margin over variable expenses (MCV)	153600	675840	40%
Fixed expenses	134400	591360	35%
Operational profit	19200	84480	5%

Results show that for the ARCTIC S.A. trade company, the break-even amounts to 87.5 %, while in absolute values, it amounts to 336,000 thousand EUR, respectively 1,478,400 thousand lei.

$$PR = \frac{134400}{153600} \times 100 = 87,5 \% \text{ of production capacity.}$$

The result for the amounts in lei for the break-even is:

$$PR = \frac{134400}{40\%} = 336,000 \text{ thousand } \text{€} \text{ respectively } 1,478,400 \text{ thousand lei.}$$

In the same, year the total costs of non-quality, represented by the cost of internal and external faults, amounting to 7,680 thousand EUR (i.e. 3 times lower than in 2010), the equivalent of 2.0% of the turnover. As a result, the variable effective costs only amount to $153,600 \times (100 - 2.0) = 150,528$ thousand EUR, while the difference, amounting to 3,072 thousand EUR, represents non-quality costs.

This result shows that the successful introduction of the TQM quality management system, combined with the methods of the continuous quality improvement system – Kaizen, meant a very close step to achieving the *zero faults* objective (*in this assessment of the result, one must consider that the Kaizen system methods were only present for three years from the total five-year period analyzed*).

As shown in the table, the turnover recorded an increase of 152%. The stabilization of the manufacturing process determined a decrease of defect costs, translated into a profit increase 1.5 times greater than in 2010. This means that a decrease of 9.2% for fault costs has determined a profit increase by approximately 50%.

In addition to these calculations, in order to obtain a clearer perspective of the impact of efficiently implementing and operating the TQM system, completed by methods from the Kaizen system, we deemed it useful to calculate the amount by which the turnover would increase, in absence of an implemented total quality management system (2005 - 2010), and of the system completed with Kaizen methods (2010 - 2014) for the profit to reach the level achieved by using this system..

The calculation formula is:

$$CA_1 = \frac{CF + (1+x)P_0}{MCV (\%)}, \text{ where}$$

CA_1 – turnover which, given the conditions at hand, allows the increase of profit by X percent;

P_0 – profit for the initial situation.

In the situation prior to implementing the quality management system, the 184 profit increase would have required an additional turnover of:

$$CA_1 = \frac{66500 + 1,84 \times 7030}{40\%} = 79435,2 \text{ thousand } \text{€}$$

$$CA_2 = \frac{90300 + 2,03 \times 12905}{39\%} = 116497 \text{ thousand } \text{€}$$

This means that, in order to obtain the same profit by incurring non-quality costs, the sale volume should have increased during the 2005 – 2010 period by 41.81%, and by 30.34% during the 2010-2014 period, when Kaizen methods were also implemented. Therefore, we believe the introduction of quality systems may provide a significant economic impact for the company, and also for the entire national economy, through a more efficient resource management, thus insuring an increase in welfare.

4. Conclusions

The case study performed represents a factual, objective and factual assessment, from a statistical standpoint, of the impact of effectively implementing a quality management system on the financial performance and economic efficiency in general. Moreover, the feasibility of the methodology for calculating the efficiency of the quality system was demonstrated.

The results provided aim to confirm the special economic capacity of businesses that have implemented the system and to reassure the management of such organization that have implemented the system of the validity of the decision made in this regard. Obviously, there are certain companies which, after obtaining the quality certificate, failed to record continuous improvement progress and fail to provide full satisfaction to their

clients. If for such organizations, the advantages of certification were do not fully meet their expectations, the causes do not reside in the limitations of the quality system, but in the manner in which it was commissioned. After certification, one needs to follow the observance of referential requirements, especially of the “*Continuous Quality Improvement*” principle, through efforts of continuous development of all processes. Yet, by the very introduction of certain quality improvement methods (in our examples, methods belonging to the Kaizen system), the businesses documented recorded a substantial increase in efficiency compared to the situation prior to introducing the quality system.

As a result, we believe that in the near future, all industrial businesses will resort to a quality system similar to the one assessed herein – *the TQM-Kaizen integrated quality improvement management system*.

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