

**MEASURING THE IMPACT OF THE QUALITY MANAGEMENT SYSTEMS
ON THE COSTS OF NON-COMPLIANCE****Donica STOYANOVA¹****JEL L 15****Abstract****Keywords:**

quality management system, costs, non-compliances, measuring.

Determining the impact of the implemented quality management system on the costs of non-compliance is significant for every organization which has adopted the Bulgarian Institute for Standardization БДС EN ISO 9001:2008 in order to enhance its efficiency. The main objective of the present paper is to provide an algorithm by means of which the organization can make estimates concerning the contribution of the present system for cutting these costs. A set of indicators is proposed for monitoring the means spent for non-conformance needs incurred in the years before and after the QMS implementation, as well as a scheme for determining the real savings the company has achieved by reducing the considered costs using the system tools.

Introduction

Nowadays more companies rely on implementing the quality management system (QMS) to increase their competitiveness. Undoubtedly, the existence of a certified system improves company's image to its current and potential partners (Costa & Martinez, 2004), aids eliminating barriers when entering new markets (Casadesuas et al., 2001) and guarantees an access to procurement contracts. However, this does not restrict the positive influence of its operation. The successfully implemented QMS is able to entail a significant cost cutting in the company, especially concerning the so called "non-conformance costs" – additionally spent means for wiping out the results of production imperfections. (Nanda, 2005).

Irrespective of whether they arise during the production process, caused by deviations from the product's characteristics, or at a later stage, as a result of a client's lack of satisfaction, the non-conformance costs are able to divert significant company's funds which are required to finance its main operations. Due to its initiatives and tools QMS has the potential not only to cut costs but also to find the reasons for their origin and anticipate suitable corrective actions which do not admit their repeated occurrence.

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The purpose of the present article is to suggest an algorithm which would be able to determine the impact of the operating management system on the non-conformance costs in the industrial companies. Its main function is to offer a clear idea to the management team about the contribution of the implemented QMS for their reduction, and the need to determine effectiveness and efficiency of its operation. For the purpose of its design it is necessary to solve the following problems:

- To explain clearly the essence and structure of the non-conformance costs, as well as the mechanism by which the implemented QMS influences their reduction;
- To select indicators for measuring the impact of the implemented QMS on the nonconformance costs;
- To produce a scheme for determining the QMS impact on the analysed costs and specifying the funds savings made as a result of the system operation.

The objects of the present theoretical study are the industrial companies which possess an implemented and certified system for quality management.

1. Characteristics of the non-conformance costs

The non-conformance costs have been an object of research since the dawn of modern theories of quality management. They exist as elements in the researched PAF model by Juran (1951) and Feigenbaum (1956) for defining the quality costs; in the works of Crosby (1979) as a point of reference for arguments; serve as a basis for the developed in 1992 British standard BS 6143:1992 “A manual in quality management” By their nature they are company losses caused by the poor quality of its manufactured or delivered production. They might arise in cases when the product characteristics do not comply with manufacturing specifications or the particular client’s needs. All funds, spent on any identified non-compliance by separate economic elements are included in their composition.

Depending on the time and place of finding the particular non-conformance, they may be divided into two large groups: costs for internal non-conformance and costs for external non-conformance. The costs for internal non-conformance occur referring to noted mistakes and diversions found before delivering the product to the client. (Dyukendzhiev and Yordanov, 2012, p. 242). All funds spent and related to the next items fall into this category:

- All defective production which is not subject to correction /waste/;
- Processing and repair of correctable flaws in the manufactured products or their elements;

- Carrying out additional monitoring initiatives and testing related to completed production.

Likewise, the external non-conformance costs are related to defects which are detected after the product has been delivered to the client. The funds spent on next items fall into this category:

- Expressed claims;
- Accrued fines, penalties and price discounts in cases of failure to comply with the contractual terms;
- Payment of liability claims pursued in a legal way concerning damages caused to the client from the product use.
- Warranty repairs, checking and replacing the faulty products.

The reduction of non-conformance costs is an essential purpose for each company. They increase the total costs of the company, the cost of the manufactured produce and reduce company's financial results. On the other hand, every external non-conformity causes not only material injury but also ruins the image of the company as a provider of high quality products and services.

The core objective of the quality management systems, developed in compliance with the clauses of BDS EN ISO 9001:2008, is to stipulate and conform to internal company regulations which will set up preconditions for reducing to a minimum the internal and external non-conformities. This can be achieved by:

- 1) Clearly defined authority and responsibilities of the recruited staff concerning the processes carried into effect in the company;
- 2) A set of advance planned preventive and monitoring events for ensuring the quality of the delivered products;
- 3) Methods for carrying out data analyses of previously originated non-compliances and looking for reasons of their occurrence;
- 4) Tools for implementing corrective and preventive activities and continuous improvement.

The described elements, which were effectively developed and implemented, are able to reduce significantly the non-conformance costs in the organization.

2. Indicators for measuring the impact of the implemented quality management system on the costs of non-conformance

The extent to which the operating QMS has managed to cause a reduction of non-conformance costs is an issue which worries every organization which adopted

the principles of The Bulgarian Institute for Standardization БИС EN ISO 9001:2008 with the aim to enhance its efficiency. In order to determine the contribution of the system in the considered direction, the appropriate indicators need to be selected and their significance has to be traced before and after their implementation.

In scientific literature there is no agreement over the issue what indicators are appropriate to be used when comparing the costs of non-conformance which occurred at different time periods. Some authors (Institute of Management Accountants, 1993) put reliance on the direct, absolute comparison of the examined costs in different years of the investigated time frame. For these periods they calculate all funds spent because of the emerged internal and external non-conformance costs and directly compare their values. Although this approach is easy to apply, it is extremely inaccurate, in our view. We, therefore, consider that it possesses two major weaknesses which make it unreliable.

- 1) The volume of production and sales respectively which caused the particular costs of non-conformance are not taken into account. As far as they are in a direct correlation if the manufactured or sold volumes are significantly reduced the funds spent on non-compliances are expected to follow the same direction of change. If the absolute indicators are applied for the needs of the analysis they will render an account that there is a reduction of investigated costs which might lead to misleading conclusions about the efficiency of the applied measures for that purpose.
- 2) Similar indicators are the bearers of the inflation which is valid in the country. That, especially in long-term aspect may distort the obtained results and lead to incorrect conclusions, too.

Most of the modern authors avoid the use of absolute indicators for studying the changes of non-conformance costs. For that purpose they prefer to use the share or the percent of the investigated costs compared to an advance selected base with a causal link between them. The indicators which the authors most frequently select to carry out analyses in the investigated trend are summarized in table 1.

Table 1

Most frequently used in literature relative indicators for comparing the costs of non-conformance which originated in different periods of time

Authors	Selected indicator
Knyazyuk (2011), Modrak (2007)	Relative share/percent of costs of non-conformance compared to the company's total costs
Sailaja, Basak and Viswanadhan (2015), Rajeev (2013), Shulepova and Morozova (2012)	Percent of non-conformance costs compared to the sales made in the relevant period
Russel and Taylor (1999)	Percent of non-conformance costs compared to company's production costs
Antonaras, Memtsa and Iacovidou (2010)	Percent of non-conformance costs compared to all quality costs

We also believe that using the relative indicators guarantees better comparability of investigated costs in different periods of company operation. Since both the numerator and denominator of the represented correlations carry in them the existing inflation in the country for the respective year, its impact is eliminated. Furthermore, the non-conformance costs are bound to company operation at every covered in the report period, which overcomes the main problem leading to misstatements when using the absolute indicators.

However, we think that the bases selected in respect of the designated indicators in table 1, are appropriate to be further refined. For example, Knyazyuk (2011) suggests that the relative share of non-conformance costs compared to the total level of company costs should be used as a monitoring value. However, the latter comprises both the operating costs and financial and additional costs. Whereas the additional costs however, may have certain bearing to contingent non-conformities, the financial ones are not related in any way to their emergence. But their amount may vary considerably over the years and distort the results of the completed statements. Their rise, for example, would increase the value of the denominator in the calculated indicator which would automatically cause a fall in its impact for the respective year. The conclusions which would misleadingly be drawn would be that the costs of non-conformance are reduced because of the specific measures undertaken in the period for their reduction which would mislead the company management team.

The second most frequently used indicator in literature monitors the percent of the investigated costs compared to the value of the production sold for the respective

period. The main problem noted in that case is caused by the fact that only the external non-conformance costs are bound to the volume of completed sales. The internal non-conformance costs originate in the process of manufacture and if at a certain period of time the company has mainly sold stocked in the warehouse production which was manufactured in previous years, reasons for doubts about the accuracy of the proposed indicator emerge again. The arguments concerning the used by Russel and Taylor (1999) “percent of non-conformance costs compared to company’s production costs” are similar, too. In a similar way the external costs of non-conformance are not related to the company’s manufacturing activity but they are related only to marketing of the finished products. Therefore, we all agree that it is necessary to introduce a differentiated approach when selecting the indicators which monitor the specific non-conformance costs over the years. The funds spent on external non-compliances have to be related to the sales completed in the period whereas the ones connected to internal non-conformance – to the volume of finished goods expressed in value terms.

The indicators used in scientific literature possess one additional drawback. Since they are calculated as a share or percent compared to the specific base, the indicators cannot give information about the particular savings of funds achieved after the certain measures have been taken, in that case after the implementation and functioning of QMS. We consider it more appropriate to establish their level for 100 levs manufactured, respectively sold production rather than looking for the percentage between the specific non-conformance costs and the selected adequate base. Thus, instead of defining the percentage points of changed non-conformance costs, we could assert the amount of funds savings that originated concerning the specific expenditure at every 100 levs manufactured production or marketed goods.

We also believe that the analysis allows a deeper exploration of the problem and more profound monitoring of the specific internal and external non-conformance costs. It is possible to establish the impact of the quality management system on every element of the investigated costs.

On the basis of the completed critical analysis and considerations, we believe that, in order to establish the contribution of the implemented QMS for reducing the particular non-conformance costs, it is appropriate to use the indicators, presented in table 2.

Table 2

Indicators for monitoring the impact of the implemented QMS on company non-conformance costs

Analysed costs	Indicator	Method of definition
External non-conformance costs	Level of costs for claims at 100BGN sales (LC_{C100i})	$LC_{C100i} = \frac{C_{Ci} * 100}{In_i} \quad (1)$ <p>where: C_{Ci} – costs for claims in year i; In_i – income from sales of goods in year i</p>
	Level of costs for fines, defaults, discounts and damages legally identified at 100 BGN of sales ($LC_{FDDDi100i}$)	$LC_{FDDDi100i} = \frac{C_{FDDDi} * 100}{In_i} \quad (2)$ <p>where: C_{FDDDi} – costs for fines, defaults, discounts and damages legally identified in year i.</p>
	Level of costs for guarantee maintenance at 100 BGN of sales (LC_{GM100i})	$LC_{GM100i} = \frac{C_{GM_i} * 100}{In_i} \quad (3)$ <p>where: C_{GM_i} – costs for guarantee maintenance, originated in respect of orders placed in year i.</p>
Internal costs of non-conformance	Level of costs for waste at 100 BGN goods produced LC_{w100i} .	$LC_{w100i} = \frac{C_{W_i} * 100}{Cp_i} \quad (4)$ <p>where: C_{W_i} - costs for waste, originated in year i; Cp_i - cost price of goods produced in the period</p>
	Level of costs for re-works and extra monitoring events at 100BGN produced goods LC_{em100i} .	$LC_{EM100i} = \frac{C_{EM_i}}{Cp_i} \quad (5)$ <p>where: LC_{EM100i} – costs for waste originating in year i.</p>

Presented in a similar way, the indicators possess the following advantages:

- They provide the opportunity for detailed analysis of the impact of the implemented QMS on the specific internal and external costs of non-conformance;
- They do not distort their results under the influence of inflation or other variables, which are not related to the investigated problem;
- They are calculated in a relevant way to the situations in which the particular costs might arise;
- They might form the basis for determining the savings of funds which occurred as a result of events and tools of the operating QMS.

A major drawback of the selected indicators is that the set of required data and the estimates based on them are much more labour-consuming compared to the alternatives offered in scientific literature.

The data sources for their calculation prior to QMS implementation tend to be the official accounting system (Profit and Loss Account, turnovers and references in statements of accounts 441, 494, 609, 692, 701), claim reports, fines and defaults, reports for rejected goods and other relevant records kept in the company. After QMS implementation the research is supplied with information by a number of specific quality records which are obligatory maintained by the requirements of BDS EN ISO 9001:2008 – mainly reports which concluded about non-compliant products; registers of expressed claims, fines and defaults, etc.

3. An algorithm for measuring the impact of the implemented quality management system on costs of non-conformance

If we want to define the impact of QMS on costs of non-conformance, it is necessary to monitor and do estimates on the basis of the selected above indicators for two periods – one immediately before the system implementation and for the whole period of its operation by different calendar years.

The indicators' value in the period before QMS implementation show the results achieved by the company in its attempts to reduce non-conformance costs until the moment the decision to implement the quality system has been taken. They provide a benchmark and operate as a point of reference for monitoring its impact on the investigated undesirable costs. Comparing to them the indicators' significance in the period after the introduction of the standards of The Bulgarian Institute for Standardization БДC EN ISO 9001:2008, conclusions can be drawn whether QMS managed to

lead to an extra reduction of external and internal non-conformance costs. On the basis of a number of estimates the particular funds savings can be determined, which were achieved in the investigated trend after implementing the system.

In this context we believe that measuring the impact of the implemented QMS on external and internal costs of non-conformance can be accomplished by gradually taking the following steps:

- 1) Calculating the values of the indicators displayed in table 2 for a period of five years prior to the system implementation and for the whole period after its certification (or a specific part of it, in compliance with the requirements of the company managers). The time frame of five years should be selected as a base period for comparison because of its sufficient length to eliminate the influence of random factors and, at the same time compact enough to report on the achieved company experience in the measures to cope with external and internal non-conformances.
- 2) Monitoring the change of the calculated indicators, looking for trends in their manifestation. It is determined whether for the period after QMS implementation there is a reduction of specific non-conformance costs at 100 BGN manufactured, respectively sold goods, compared both to the above studied five-year period and to the different years of system operation. Depending on the specific numbers conclusions are drawn about the way the company consistently and permanently managed to influence the investigated costs through QMS tools.
- 3) Determining the savings of the specific costs of non-conformance at 100 BGN manufactured and sold goods by the year of system operation compared to the period of its implementation. What is used as base value of indicators is the average chronological value of the meanings of the particular indicators during the five years immediately after the system certification. If, however, even at the stage prior to system implementation, an explicit tendency for reducing the levels of the investigated costs is determined, it is advisable to use the meanings of indicators for the year immediately prior to the adoption of standards of BDS EN ISO 9001:2008. This is because they give an account of the latest achievements of the company in its efforts to reduce the costs of non-conformance.

The savings of the particular non-conformance costs which are achieved at 100 BGN manufactured production, respectively sales after QMS implementation are defined as follows:

$$SC_{C100i} = LC_{c100i} - LC_{c100b} \quad (6)$$

$$SC_{FDDDI100i} = LC_{FDDDI100i} - LC_{FDDDI100b} \quad (7)$$

$$SC_{GM100i} = LC_{GM100i} - LC_{GM100b} \quad (8)$$

$$SC_{W100i} = LC_{W100i} - LC_{W100b} \quad (9)$$

$$SC_{EM100i} = LC_{EM100i} - LC_{EM100b} \quad (10)$$

where:

SC_{C100i} – savings of costs for claims at 100 BGN sales for different years of QMS operation;

$SC_{FDDDI100i}$ – savings of costs for fines, defaults, discounts and damages, legally stated at 100 BGN sales for different years of QMS operation;

SC_{GM100i} – savings of costs for guarantee maintenance at 100 BGN sales for different years of QMS operation;

SC_{W100i} - savings of costs for waste at 100 BGN manufactured goods for different years of QMS operation;

SC_{EM100i} – savings of costs for rework and extra monitoring events at 100 BGN manufactured goods for different years of QMS operation;

LC_{c100b} , $LC_{FDDDI100b}$, LC_{GM100b} , LC_{W100b} , LC_{EM100b} - over the basis indicators value for the period prior to QMS implementation dependent on the established direction of their development;

i - consecutive year in the studied period;

$i \geq 6$, at a studied period of five years prior to QMS certification.

- 4) Defining the actual savings of specific non-conformance costs in the period after QMS implementation. For this purpose a recalculation is done for the implemented reduction of studied costs by different years for the whole volume of manufactured respectively sold goods:

$$SC_{Ci} = \frac{SC_{C100i} * In_i}{100} \quad (11)$$

$$SC_{FDDDi} = \frac{SC_{FDDDI100i} * In_i}{100} \quad (12)$$

$$SC_{GMi} = \frac{SC_{GM100i} * In_i}{100} \quad (13)$$

$$SC_{Wi} = \frac{SC_{W100i} * In_i}{100} \quad (14)$$

$$SC_{EMi} = \frac{SC_{EM100i} * In_i}{100} \quad (15)$$

where:

SC_{Ci} , SC_{FDDDi} , SC_{GMi} , SC_{Wi} , SC_{EMi} – actual saving of specific non-conformance costs in different years of QMS functioning;

$i \geq 6$, at studied period of five years prior to QMS certification.

The indicators in this group reflect the additional costs for specific non-compliances which the company might fulfill if the same amount of production was manufactured in the conditions prior to QMS implementation, but, currently it has saved them.

5) Determining the total savings of costs of non-conformance (SC_i), achieved after the QMS implementation by different years of its functioning.

$$SC_i = SC_{Ci} + SC_{FDDDi} + SC_{GMi} + SC_{Wi} + SC_{EMi} \quad (16)$$

where:

i - consecutive year in the studied period;

$i \geq 6$, at a studied period of five years prior to QMS certification.

On the basis of the completed estimates by different years of QMS functioning we can judge whether the system after applying its instruments, managed to cause a permanent reduction of non-conformance costs and what funds are saved to the company by using its instruments. In general, all values of (SC_i), greater than zero attest the presence of fulfilled savings in the respective calendar year. In order to draw the conclusion that QMS has had a significant impact on the level of non-conformance costs it is required that a permanent tendency should be established for generating such savings in the whole period of QMS operation. Otherwise, we can only talk about reducing the investigated costs, which was generated by random factors.

Conclusion

Measuring the impact of the implemented and operating quality management system on the costs of non-conformance has a major significance for every organization looking for efficiency. The algorithm which was looked at provides a possibility to monitor the changes which have occurred in the level of costs for internal and external non-conformances caused by the QMS implementation, and calculating the achieved savings as results in the researched trend. The information obtained can be used successfully by the company's senior management for performing subsequent estimates about the efficiency and effectiveness of the implemented system.

However, it is necessary to pay attention on the fact that the QMS has the potential to reduce the non-conformance costs, aiming at the reasons for their occurrence only if it was effectively implemented. If the company resorts to adoption of BDS EN ISO 9001:2008 only for the sake of the certificate the system could not be expected to bring about a significant reduction of funds spent in this direction.

The implementation of the proposed algorithm and of all future estimates concerning the evaluation of QMS could be made significantly easier if company's key quality records are integrated in the accounting software which was made use of. Thus, the values of the integrators looked for by the management will be worked out automatically without time and efforts lost in collecting data and doing calculations.

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