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Costs in Selected Manufacturing  
Enterprises**

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## **COMPLIANCE AND NON-COMPLIANCE COSTS IN SELECTED MANUFACTURING ENTERPRISES**

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Key words: quality cost, compliance costs, non-compliance costs.

### **A b s t r a c t**

Quality cost analysis is considered a very important instrument used in quality economics. Interpretation of changes in the quality cost level, cost optimisation effectiveness and indicating the directions for quality improvement plan verification represent the subject of this analysis.

Evaluation of the compliance and non-compliance costs in the development of quality costs in a selected enterprise during the years 2004–2009 was the main goal of this study. A limited liability company conducting manufacturing activity in the province of Warmia and Mazury was selected which mainly produces accessories to automotive vehicles and machines.

As the result of the conducted studies, the following ultimate conclusions were formulated:

- quality costs in the enterprise surveyed showed an increasing trend during the years 2004–2007 and as of 2008 a decreasing trend was observed (in 2009 they decreased by 17% as compared to 2008),
- the ratio of losses from the total defective production during the years 2004–2006 showed a decreasing trend; the significant change in the value of defective products manufactured proves the efficiency of the quality management system applied in the company,
- with the increase in the costs of activities related to preventing poor quality, the costs of defective products and the total quality costs decrease.

### **KOSZTY ZGODNOŚCI A KOSZTY NIEZGODNOŚCI W WYBRANYM PRZEDSIĘBIORSTWIE PRODUKCYJNYM**

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Słowa kluczowe: koszty jakości, koszty zgodności, koszty niezgodności.

### Abstrakt

Analizę kosztów jakości uznaje się za bardzo istotny instrument wykorzystywany w ekonomice jakości. Przedmiotem tej analizy jest interpretacja zmian w kształtowaniu się poziomu kosztów jakości, ocena skuteczności optymalizacji kosztów oraz wskazanie kierunków weryfikacji planu doskonalenia jakości.

Głównym celem badań jest ocena roli kosztów zgodności i kosztów niezgodności w kształtowaniu się kosztów jakości w wybranym przedsiębiorstwie w latach 2004–2009. Podmiotem badań jest spółka z o.o., prowadzącą działalność produkcyjną na terenie województwa warmińsko-mazurskiego. Dominującym rodzajem działalności tej firmy jest produkcja akcesoriów do pojazdów samochodowych i maszyn.

W wyniku przeprowadzonych badań sformułowano następujące wnioski końcowe:

- koszty jakości w badanym przedsiębiorstwie wykazują w latach 2004–2007 tendencję wzrostową, a począwszy od 2008 r. tendencję spadkową (w 2009 r. zmniejszyły się o 17% w porównaniu z 2008 r.);
- wskaźnik strat z tytułu produkcji wadliwej ogółem w latach 2004–2006 ma tendencję malejącą; istotna zmiana wartości wytwarzanej produkcji wadliwej dowodzi, że funkcjonujący w spółce system zarządzania jakością przynosi odpowiednie efekty;
- wraz ze wzrostem kosztów działań związanych z zapobieganiem złej jakości następuje spadek kosztów produktów wadliwych oraz kosztów całkowitych jakości.

## Introduction

Achieving and maintaining high product quality generally requires implementation of appropriate quality management methods and procedures in an enterprise. A functioning quality management system shows the commitment of the enterprise to increasing the quality of products which, at the same time, offers the opportunity of winning higher customer confidence and increasing the enterprise's rank. Those activities lead to strengthening the market position of the enterprise and gaining a competitive advantage.

Quality costs represent an economic instrument to evaluate the quality management system in an organisation. Identification and indication of the places and causes of their appearance are crucial elements in the quality cost analysis. A correctly conducted quality cost analysis determines the quality of decisions taken on its basis by the staff managing the quality systems of the organisation.

John Bank lists three major types of quality costs (they are divided further into numerous components), namely:

- compliance costs (they are divided into prevention costs and evaluation costs),
- non-compliance costs (divided further into internal errors costs, external errors costs and costs of exceeding the requirements),
- costs of lost benefits (BANK 1997, p. 33)

The internal quality assurance costs represent the sum of compliance and non-compliance costs. The term "compliance" describes the extent to which the product shows compliance with the design specification while from the

perspective of the client it should describe the extent to which the product satisfies his requirements. The term “non-compliance” refers to deviations from customer requirements, which is simply called the error (*Zarządzanie przez jakość...* 2003, p. 421). The non-compliance costs include the costs of internal errors and costs of external errors. The place of non-compliance detection and revelation is assumed as the criterion for that division. The costs of internal errors are the costs related to detection of non-compliance prior to transferring the product to the buyer. The external costs are the costs which appear after transferring the product to the user (BALON 2006, p. 18).

Evaluation of the role of compliance and non-compliance costs in quality costs development in the selected enterprise during the years 2004–2009 was the major goal of the studies.

The following detailed objectives were formulated for achievement of the main goal:

- determination of the quality cost structure in the company surveyed,
- determination of the level of losses for defective production in the total revenues of the enterprise,
- determination of the correlations between individual quality cost items recorded in the enterprise.

## **Goals and principles of quality cost analysis**

Quality cost analysis is considered the basic instrument used in quality economics. Interpretation of changes in the development of quality cost level, cost optimisation effectiveness evaluation and indicating the directions for a quality improvement plan are the subject of this analysis. Providing data on the development of costs according to different groups of cost types as well as explaining the reasons for such costs represents the main task of cost analysis in the organisation.

The goals of quality cost analysis are:

- identification of all type of activities that lead to obtaining the required product quality, regardless of the organisational division in the given enterprise,
- determination of the costs of those actions and operations,
- interpretation of the data obtained and making it available to the interested persons and entities,
- seeking opportunities to optimise the manufacturing quality costs,
- organising regular observation and registration of trends for the quality costs recorded (KOLMAN 2009, p. 397).

This analysis should also allow determination of the influence of quality costs on the financial result of the entity (KOLMAN 2009, p. 397). Quality cost

analysis implementation and including it in the quality management system fulfils the following functions:

- it creates the opportunity to increase the quality management system effectiveness,
- it provides a basis for making decisions on quality issues in the enterprise,
- it surfaces the areas and opportunities for quality cost optimisation (NOWAK et al. 2004, p. 245).

To achieve the above-specified goals, quality costs may be analysed employing different indicators and measures or diversified contextual variables and employ diversified tools and techniques (Fig. 1.).

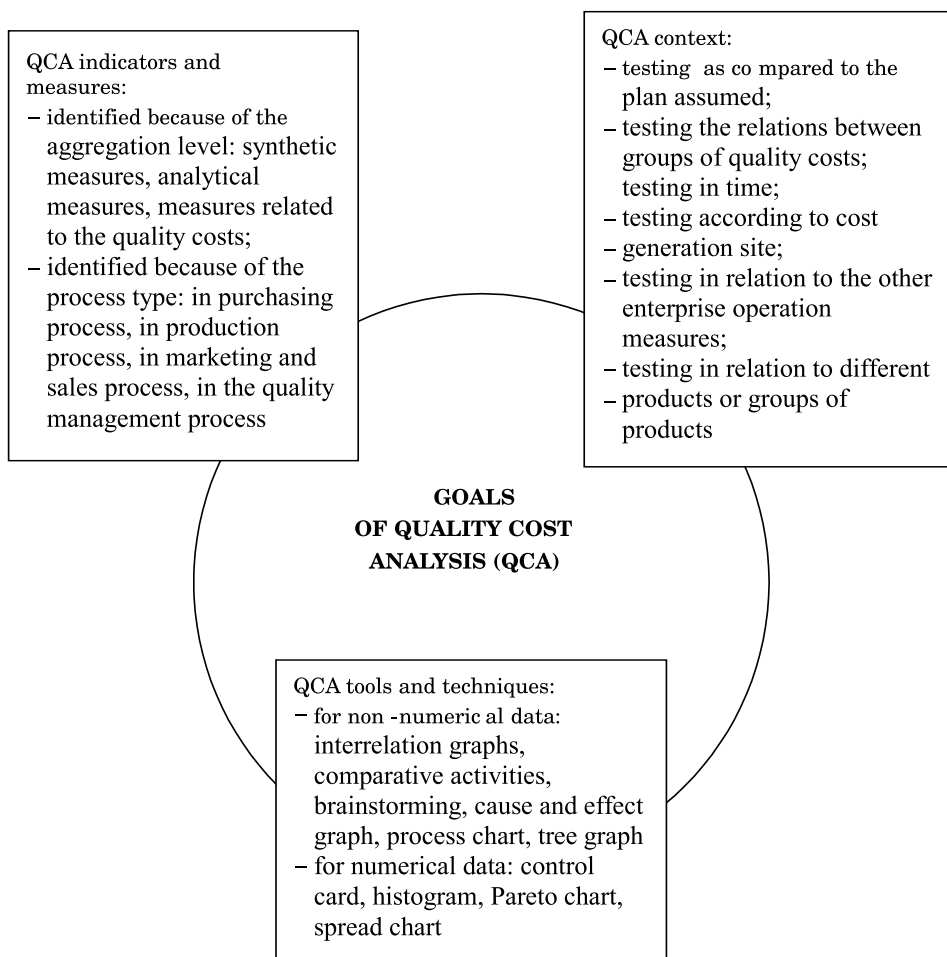


Fig. 1. Fundamental variables in the quality cost analysis

Source: based on JEDYNAK 2007, p. 143.

Quality cost measurement and analysis offers numerous benefits to organisations. The most important are:

- they provide a basis for understanding the processes occurring in the enterprise,
- they provide the possibility for making the right decisions by revealing places where high quality costs occur,
- they form the foundations for rational material, financial and human asset management,
- they lead to increasing the operational effectiveness by focusing efforts and resources within the area of priority from the perspective of enterprise efficiency,
- they provide information relating to the level of quality control system performance in the organisation (KISTER 2003, p. 16).

As a consequence, quality cost analysis should represent a kind of a test and verification tool concerning the quality management system efficiency and effectiveness. It is also a tool to evaluate the specific enterprise management processes (SZCZEPAŃSKA 2009, p. 6).

### **Methodological assumptions of the survey**

A limited liability company conducting manufacturing activities in the province of Warmia and Mazury was the object of the study. The company was mainly involved in the production of accessories for automotive vehicles and machines.

In the context of the goals assumed, the following research hypothesis was formulated: the increase of costs of preventing defective quality causes a decrease in the costs of losses resulting from production of defective products and, as a consequence, assures a decrease in the total quality costs.

The research material was gathered by applying the documentation method. Documents concerning the quality policy as well as periodic reports on quality costs made available by the company surveyed were used. The method of vertical comparisons which serves to compare phenomena in the economic entity during different survey periods was employed. The inductive method was used for drawing conclusions.

### **Results of surveys**

Table 1 presents the total costs of quality and their components recorded in the surveyed company during the years 2004–2009.

Table 1  
Total costs of quality (in PLN) and sales of the enterprise surveyed during the years 2004–2009

Item	Year					
	2004	2005	2006	2007	2008	2009
Compliance costs, including	14,000	14,000	14,400	14,400	17,200	19,400
– costs of preventing poor quality	6,000	6,000	6,200	6,200	6,800	6,800
– quality evaluation costs	8,000	8,000	8,200	8,200	10,400	12,600
Non-compliance costs	59,790	63,003	70,253	110,632	100,640	78,369
Total quality costs	73,790	77,003	84,653	125,032	117,840	97,769
Sales [K PLN]	2,193.90	3,075.30	3,224.90	3,530.30	3,107.60	5,078.30

Source: own work based on the registry of quality costs during the years 2004–2009.

Table 2 presents the structure of quality costs in the enterprise surveyed.

Table 2  
Structure of the total quality costs during the years 2004–2009 (%)

Item	Year					
	2004	2005	2006	2007	2008	2009
Costs of preventing bad quality	8.13	7.79	7.32	4.96	5.77	6.96
Quality evaluation costs	10.84	10.39	9.69	6.56	8.83	12.89
Non-compliance (defects) costs	81.03	81.82	82.99	88.48	85.40	80.15
Total	100.00	100.00	100.00	100.00	100.00	100.00

Source: own work based on the register of quality costs during the years 2004–2009.

The costs of defective products (over 80%, and in 2007 almost 89%) have the largest share in the quality costs every year. Resignation from contractors that, as was discovered, until the end of 2006 performed some of the production work reliably was the main cause for the increase in the share of defective products in the quality costs in 2007. An analysis of the total quality costs during the surveyed period also indicated that the share of the prevention costs in the total quality costs decreased during the years 2004–2007 reaching a low in 2007 and then showed an increasing trend during the following years. The same situation occurred regarding the evaluation costs. The share of the costs of defects in the total quality costs, after the period of increase during the years 2004–2007, decreased during the years 2008–2009 (in 2007 – 88.48%, and in 2009 – 80.15%).

The costs of internal defects during the period surveyed represented over 90% of the total non-compliance costs and year-upon-year their share increased (Tab. 3 and Fig. 2): from 91.87% in 2004 to 96.68% in 2009. This means that almost all cases of non-compliance with the client requirements were

detected at the enterprise prior to the delivery to the buyer. The costs of external defects represent, as a consequence, less than 10% of the total non-compliance costs, which indicates an effective system for detecting defective products was in operation in the enterprise.

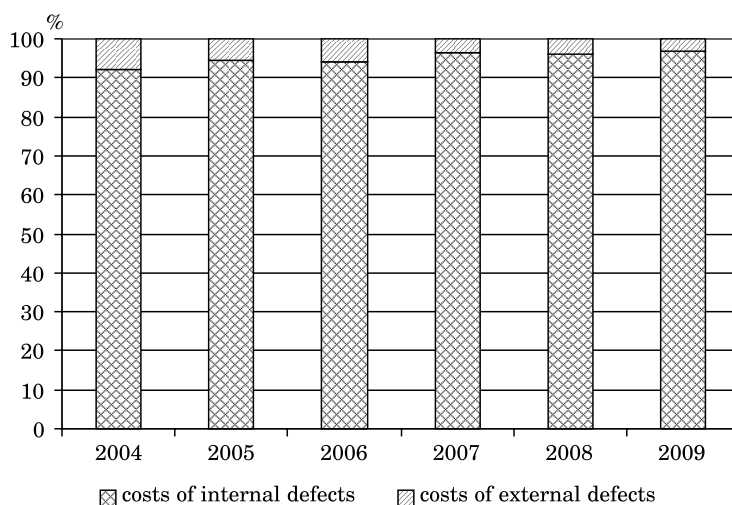


Fig. 2. Structure of non-compliance costs during the years 2004–2009 [%]

Source: own work based on the register of quality costs during the years 2004–2009.

The indicator of total losses from defective production represents the percent ratio between the value of total losses from defective production (i.e. total non-compliance costs) and sales (Fig. 3).

Figure 3 indicates that the indicator of total losses from defective production during the years 2004–2005 was decreasing (from 2.73% to 2.05%) and then increased, reaching the maximum at 3.24% in 2008. In 2009, a rapid decrease of this indicator to the level of 1.54% occurred. Such fluctuations of the indicator of losses from defective production indicate, on the one hand, that the organisation must develop a more efficient system to decrease the losses resulting from defective production, while on the other hand, it can be assumed that the significant decrease in the value of defective production in 2009 is a sign of improvement in that area over the consecutive years.

The indicator of losses on internal defects represents the ratio of losses on internal defects to the total value of sales. The value of losses on internal defects, the dynamics of the losses and their share in total losses during the years 2004–2009 are presented in table 3.



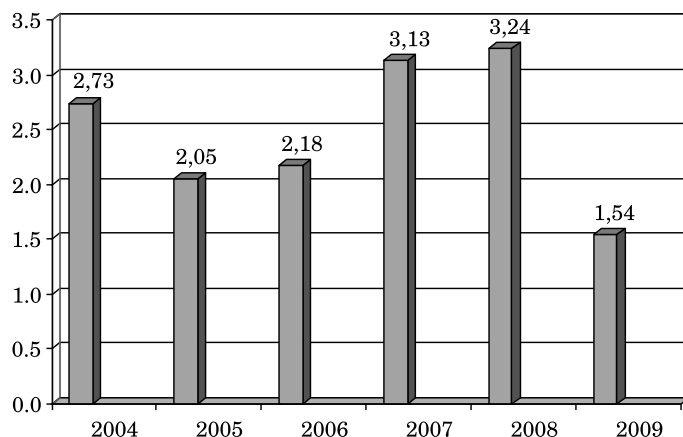


Fig. 3. Indicator of overall losses on faulty production during the years 2004–2009 [%]

Source: own work based on the register of quality costs during the years 2004–2009.

Table 3

Value of losses on internal defects

Year	Value of losses on internal defects [PLN]	Dynamics [%] (value of losses for the current year / value of losses for the past year)	Losses ratio [%] (value of losses on internal defects / value of sales × 100)
2004	54,990	–	2.51
2005	59,403	108.03	1.93
2006	66,053	111.19	2.05
2007	106,532	161.28	3.02
2008	96,740	90.81	3.11
2009	75,769	78.32	1.49

Source: own work based on the register of quality costs during the years 2004–2009.

On the basis of the data presented in table 3 it can be concluded that the value of losses on internal defects increased during the years 2004–2007, e.g. in 2005 the value of losses on internal defects increased by 8.03% as compared to 2004 while in 2007 it represented over 161% of the value for the preceding year. Only during the years 2008–2009 that value started decreasing to the level of PLN 75,769 (in 2009). The average ratio of losses during the period covered (arithmetic average) was at the level of 2.35%. In 2008 it reached the level of 3.11% (the maximum during the period surveyed) while already in 2009 it decreased by more than a half. Losses caused by the employees, losses resulting from the process and losses caused by other undetermined causes were the main causes for losses on the internal defects in both 2007 and 2008.

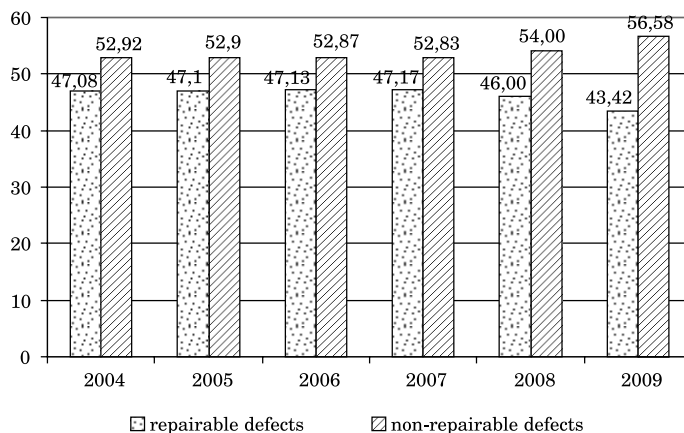


Fig. 4. Structure of costs of the internal defects during the years 2004–2009 [%]

Source: own work based on the register of quality costs during the years 2004–2009.

Figure 4 presents the structure of the internal defect costs and shows that irreparable defects were the main cause of these costs. This means that a proportion of products manufactured are unsuitable for repair and those products cannot be used according to the original intended use. The costs of repair are, in this case, so high that the products are withdrawn from trade and passed for physical liquidation. During the years 2004–2007, the costs of irreparable defects averaged 53% of the internal defects costs. During consecutive years, an increase was recorded and in 2009 their share in the costs of internal defects reached almost 57%, representing around 44% of the total quality costs.

Figure 5 presents the structure of the costs of external defects which include the costs of claims, costs of guarantee repairs and losses from withdrawal of finished products. The costs of claims have the highest share in the external defect costs, representing 80%-90% of such costs. In 2009, a decrease in the costs of claims by exactly 20% as compared to 2008 was recorded. Despite the evident increase in production, the value of products covered by claims decreased. The lowest costs related to returns of products were incurred during the years 2005, 2007 and 2008; they represented ca. 8% of the total external defects costs.

The highest costs caused by returns of defective products occurred in 2009, increasing almost three-fold as compared to 2008. The costs of guarantee repairs were incurred in 2007 only and they represented slightly less than 4% of the total external defect costs.

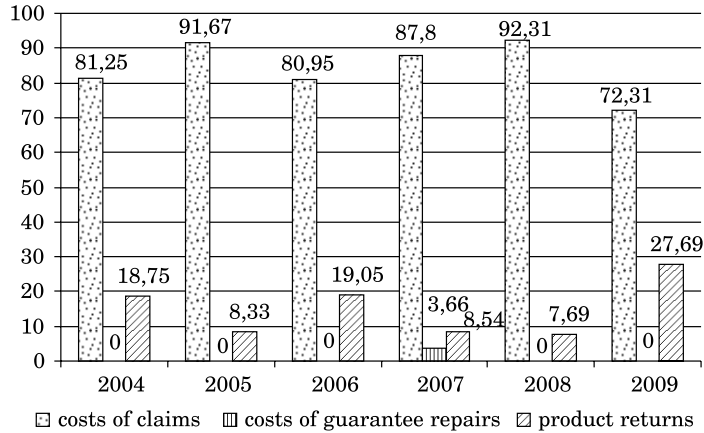


Fig. 5. Structure of the external defects costs during the years 2004–2009 [%]

Source: own work based on the register of quality costs during the years 2004–2009.

Table 4

Value of losses on external defects

Year	Value of losses on external defects [PLN]	Dynamics [%] (value of losses for the current year / value of losses for the past year)	Losses ratio [%] (value of losses on external defects / value of sales × 100)
2004	4,800	–	0.22
2005	3,600	75.00	0.12
2006	4,200	116.67	0.13
2007	4,100	97.62	0.12
2008	3,900	95.12	0.13
2009	2,600	66.67	0.05

Source: own work based on the register of quality costs during the years 2004–2009.

Table 4 indicates that the value of losses on external defects in 2005 decreased by 25% as compared to 2004 while in 2006 it increased to 16.67%. During the subsequent years the value of those losses decreased slightly. In 2009, the value of losses on internal defects decreased by as much as 33.33% as compared to 2008. The ratio of losses in 2004 was 0.22% and during subsequent years it decreased to remain at the level of 0.12%–0.13% and it reached just 0.05% in 2009.

Figure 6 illustrates the relationship between costs of low and high quality in the surveyed company.

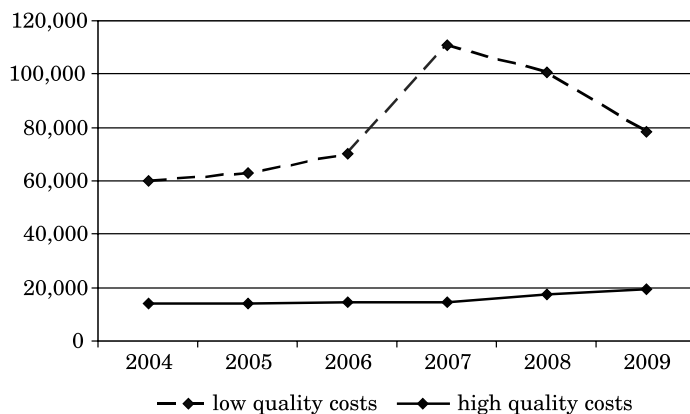


Fig. 6. Level of low and high quality costs during the years 2004–2009 [PLN]

Source: own work based on the register of quality costs during the years 2004–2009.

High quality costs during the years 2004–2007 amounted to ca. PLN 14,000 to increase slightly to the amount of almost PLN 20,000 in 2009. Figure 6 shows that the low quality costs increased during the years 2004–2007 from slightly under PLN 60,000 (2004) to over PLN 110,000 (2007). In 2008, the low quality costs decreased by just over 9% as compared to 2007. At the same time, an increase in high quality costs by almost 20% was recorded. In 2009, with the increase in preventive activity costs and evaluation costs, the low quality costs also decreased.

Figure 7 presents the curve of total quality costs during the period surveyed. In its shape, the curve resembles the curve illustrating the low quality costs (Fig. 6).

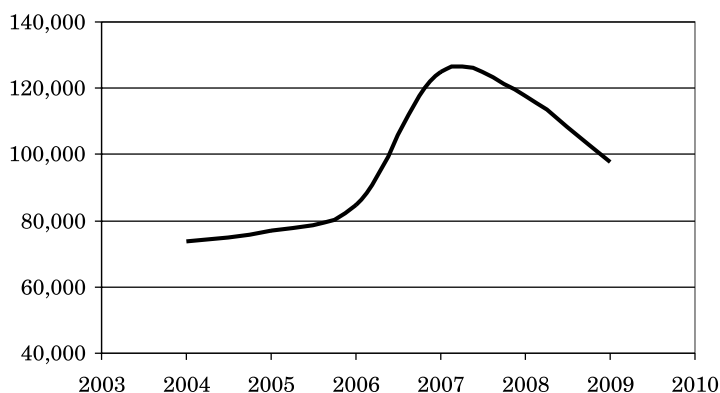


Fig. 7. Curve of total quality costs for the years 2004–2009 [PLN]

Source: own work based on the register of quality costs during the years 2004–2009.

The company surveyed incurred the highest quality related costs in 2007 (over PLN 125,000). In 2008, the level of total quality costs decreased by almost 6% as compared to 2007. On the other hand, in 2009, the level of those costs was more than 17% lower than the year before and amounted to PLN 97,769. Along with the decrease in low quality costs, the total quality costs also decreased.

### Summary and conclusions

Quality cost analysis allows evaluation of the quality management system functioning in the given enterprise. Thanks to the conclusions from this analysis, undertaking appropriate activities to limit the quality costs incurred and prevent poor quality is possible.

As a result of the conducted studies, the following ultimate conclusions were formulated:

- quality costs in the enterprise surveyed showed an increasing trend during the years 2004–2007 and as of 2008 the decreasing trend was observed (in 2009 they decreased by 17% as compared to 2008,

- the ratio of losses from the total defective production during the years 2004–2006 showed a decreasing trend; the significant change in the value of defective products manufactured proves that the quality management system applied in the company was effective,

- with the increase in the costs of activities related to preventing poor quality, the costs of defective products and the total quality costs decreased.

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