Total Quality Management & Business Excellence

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/ctqm20

How Slovak small and medium manufacturing enterprises maintain quality costs: an empirical study and proposal for a suitable model

Anna Šatanová[b], Ján Závadský[a], Mariana Sedliačiková[b], Marek Potkány[b], Zuzana Závadská[a] & Miroslava Holíková[b]

[a] Institute of Managerial Systems, Matej Bel University, Francisciho 8, 058 01 Poprad, Slovak Republic

[b] Faculty of Wood Sciences and Technology, Technical University, 960 53 Zvolen, Slovak Republic

Published online: 21 May 2014.

To cite this article: Anna Šatanová, Ján Závadský, Mariana Sedliačiková, Marek Potkány, Zuzana Závadská & Miroslava Holíková (2014): How Slovak small and medium manufacturing enterprises maintain quality costs: an empirical study and proposal for a suitable model, Total Quality Management & Business Excellence, DOI: 10.1080/14783363.2014.916477

To link to this article: http://dx.doi.org/10.1080/14783363.2014.916477

Total Quality Management, 2014
http://dx.doi.org/10.1080/14783363.2014.916477

How Slovak small and medium manufacturing enterprises maintain quality costs: an empirical study and proposal for a suitable model

Anna Šatanová[b], Ján Závadský[a*], Mariana Sedliačiková[b], Marek Potkány[b], Zuzana Závadská[a] and Miroslava Holíková[b]

[a]*Institute of Managerial Systems, Matej Bel University, Franciscihо 8, 058 01 Poprad, Slovak Republic;* [b]*Faculty of Wood Sciences and Technology, Technical University, 960 53 Zvolen, Slovak Republic*

This paper deals with the quality costs control in small and medium-sized manufacturing enterprises (SMEs) in Slovakia and also presents the results from the questionnaire survey. The empirical study attempts to determine the level of understanding and level of implementation of quality costs control in SMEs in Slovakia. The research is based on the prevention–appraisal–failure model. In the paper we also propose a suitable model for quality costs control in small and medium manufacturing enterprises based on the results of the research. The empirical study focused on SMEs where quality cost control often works as a latent management subsystem. Managers of SMEs use indicators for monitoring process performance and production quality, but they usually do not develop a separate framework for measuring and evaluating quality costs. We asked them to what extent and on what level quality costs control was used in their manufacturing.

Keywords: quality costs (control); research; small and medium size enterprises

1. Introduction

The main goal of the paper is to present the idea of quality costs control as a framework design stemming from the particular conditions of small and medium manufacturing enterprises' practices in Slovakia. The research was carried out with a selected sample of small and medium manufacturing enterprises focusing on the current state of awareness and the potential of quality costs control. The aim of this activity was to answer the basic question: 'To what extent and on what level is controlling of quality costs used in manufacturing in small and medium enterprises in Slovakia?'.

As a research objective, small and medium enterprises were the target. There are approximately 23 million small and medium-sized manufacturing enterprises (SMEs) in the European Union that offer approximately 75 million work places that represent 99.8% of all enterprises. Within Slovakia, SMEs represent about 99.1% of all registered enterprises. SMEs show flexibility in using progressive technologies, are a driving force for economic development and job creation and are the main initiators of the growth of living standards' within each country. According to the recent data of the Agency for Small and Medium Enterprise Development, in 2011 there were 153,283 small and medium enterprises (excluding sole traders) registered in Slovakia (Potkany, 2011).

For the purpose of collecting financial data for the research addressing the enterprises, a random sampling of 300 SMEs was selected from various areas of the national economy of the Slovak Republic. The empirical research was specifically targeted at finding the

*Corresponding author. Email: jan.zavadsky@umb.sk

current level of use of tools for monitoring specific groups of quality costs, their evaluation, and organisational security from the viewpoint of a responsible controller by using process management. The basis for quality costs controls in SMEs can be found in the implementation of the models and the conditions that were created previously. This model should help enterprises create a compact reporting system for monitoring the quality costs and their evaluation.

The research methodology consists of four phases. In the first phase, methods of summary, synthesis, and analogy of the knowledge were used and a short review was prepared. In the second phase, a questionnaire was used to perform an empirical study, which represents an analysis of the situation of the resolved subject matter within an enterprise practice of manufacturing in SMEs in Slovakia. When working on the fundamental part of the questionnaire, the model of quality cost monitoring was based on the prevention–appraisal–failure (PAF) principles (prevention, appraisal, costs of failure). This questionnaire was evaluated according to graphic and description methods. In the third phase, a model of the quality costs control for small and medium manufacturing enterprises was designed. Each model generally represents a real situation. We can use the models for describing economical, social, or biological systems. We can also use the principles for modelling of biological systems as Mitro and Hijová (2006) and Mitro et al. (2008) did for the function of the heart.

2. Literature review

Quality costs are very closely linked to a company's productivity and its performance. Al-Dujaili (2013) presents research aimed at discovering a relationship between the quality improvements, quality costs, and productivity. By defining the concept of quality control, referring to the types of quality costs – prevention costs, appraisal costs, internal and external failure costs – and seeking to measure the impact of the quality improvement on productivity and costs, an opportunity for the company to improve is created. One of the first authors to write about quality costs is Juran (1988). He describes the quality cost optimum model which is a baseline for other models. He mentions quality cost in most of his publications (Juran, 1994; Juran, 1995). Same quality costs categories were classified in the study of Su, Shi, and Lai (2009) in terms of a trade-off relationship (increase of control costs resulting in the decrease of failure costs and vice versa). Integrated time delays in the statistical analysis were used to compute a balanced point of quality costs, which can provide a useful guidance on quality costs savings. Srivastava (2008) used these categories through the define-measure-analyse-improve-check methodology for quality costs analysis, to identify significant quality costs drivers and then to suggest measurements and directions for the next research. Branca and Catalão-Lopes (2011) contributed to the academic research, through updating the traditional PAF approach by the strategic reaction of other companies, which affects market shares and profits.

Analyses of costs and motivation for quality implementation were completed through a survey by Tye, Halim, and Ramayah (2011), who explored the assumption that the implementation of quality costs helps companies to increase quality and as such, decrease the number of complaints, in line with reducing failure costs and total quality costs and improve the volume of sales. Weinstein, Vokurka, and Graman (2009) presented the cost of quality/cost of maintenance system as a foundation for effective improvement and a source of information where the resources should be allocated with the aim of increasing quality and fixing quality problems. The system provides new channels for communication to achieve a better understanding of the statistical capability and reliability

of equipment. Yang (2008) focused on improvement of the definition and quantification of quality costs, which was demonstrated by using different formats in a quality account matrix to calculate several types of total costs, including the share of responsibility among relevant departments. Gavurová, Šoltés, and Balloni (2014) emphasize effective strategic control including costs by company's information system.

The economic effects of quality improvement were reviewed by Eben-Chaime (2013), who demonstrated that the decrease of production costs in order to achieve lower quality levels is not an economic advantage (Freiesleben, 2005), but vice versa – production costs could increase rapidly due to low quality levels. Liapis, Theodorou, and Zannikos (2013) tried to estimate the costs associated with quality failures. The results stressed the importance and the critical role of total quality management (TQM) system being implemented in the company in order to improve its performance, in terms of costs reduction and customer satisfaction. Kajdan (2007) combined the stream performance indicators with quality indicators to optimise the process on the bases of costs minimisation. The trade-off relationship between the quality costs was defined in a study by Lin, Huang, and Chiang (2012) related to a new product development, and showed that the impact of innovation speed on a project's success is mediated by development cost and product quality. Traditionally, design quality and conformance quality are considered separately in literature. In the paper by Wu (2010), both quality dimensions were integrated into stylised quality decision models for synthesising quality cost design, conformance to quality cost, and product revenue components.

The measurement and estimation of quality costs appear to be a critical point for a company's improvement in all areas of business. Jaju, Mohanty, and Lakhe (2009) have demonstrated that measuring the quality costs provides a space of quality improvements and guidelines to TQM programme implementation. The relationship between conformance costs and non-conformance costs was measured by Omurgonulsen (2009). The increase of conformance costs caused a decrease in non-conformance costs, which implies that the negative relation between conformance and non-conformance costs could be attributed to external failure costs rather than internal failure costs. Sansalvador and Brotons (2013) developed a tool to improve the company's estimation of quality costs using fuzzy logic, taking into consideration the hidden quality costs. The final data analysis is made through the usage of both linear and possibility regressions. On the other hand, Özkan and Karaibrahimoğlu (2013) argued that a precise measurement requires a well-established accounting system providing accurate costs. It was found that the use of activity-based costing as a source of measurement of quality costs might be used to spot the quality-related activities and to identify the possibilities for improvement in the production process. A paper by Chiadamrong (2003) presented an empirical model of quality as a function of the traditional costs model (PAF expenses) and hidden-opportunities in quality loss costs. This approach provides us a view of tracking costs not only associated with production, but additionally with costs associated with quality.

Chen and Yang (2003) established an evaluation system measuring the company's performance using total involved quality costs, which includes a common measurement language – money and very simple and visible numbers along with direct and indirect loss ratios. A novel hybrid model, developed by Tsai and Hsu (2010), could cope with the interdependencies between the criteria and they proposed a demonstration of how to select the optimal costs of a quality model for an organisation.

A study performed by Lari and Asllani (2013) has tied the quality costs to operational processes and has introduced a management support system in order to help the companies to continuously measure, check, and minimise quality costs. The research, linked to the

quality standards ISO 9001 and quality awards of the Malcolm Baldrige National Quality Award and European Foundation of Quality Management, has proved that quality cost models can be used to measure the overall performance of a company. Fassoula (2005) addresses processes with a direct or indirect impact on quality costs, aiming at process-oriented diagnostic tool implementation followed by assessment procedures for goal setting and action planning. Re-examination of the quality costs trade-off presented by Freiesleben (2004) has detected an out-dated perspective on quality improvement. To prevent the static view and achieve the optimal quality level, Freiesleben suggested using profit instead of a cost perspective. Pires, Cociorva, Saraiva, Novas, and Rosa (2013) investigated whether the companies which adopted the international standards ISO 9001 are tempted to monitor the quality costs, either coming from failures or the activities undertaken. The result showed a lack of planning, control, identification, and segregation of quality-related costs. Wilford (2007) investigated the relationship between gaining an award for quality and high organisational performance. Companies need to fulfil certain criteria in order to be awarded, however this award does not ensure business excellence.

3. Empirical study in small and medium manufacturing enterprises

The aim of the empirical research was to discover the level of understanding and the level of implementation of quality costs control in Slovak small and medium manufacturing enterprises as well as the identification of potential possibilities and interest in implementation of the subject matter into an enterprise's practice for the future. Partial aims of the research were to find out if an enterprise practice in the given area corresponds with modern knowledge of theory, to process data gathered and consequently to formulate findings and recommendations which would enrich theory and would contribute to a better practice of quality for an enterprise.

3.1. *Data collection*

The proposed questionnaire included 11 questions:

Q1: Do you think that quality costs control is the same as quality management?
Q2: Do you deal with monitoring the following groups of costs on quality in your enterprise?
Q2a) Do you deal with monitoring the prevention costs?
Q2b) Do you deal with monitoring the appraisal costs?
Q2c) Do you deal with monitoring the internal failure costs?
Q2d) Do you deal with monitoring the external failure costs?
Q3: Do you have your own methodology for evaluation of quality costs?
Q4: Do you have within your enterprise a position of a quality controller or any other position dealing with monitoring and appraisal of quality costs?
Q5: Is your enterprise an owner of any ISO standards certificate?
Q6: Do you have a process map created in your enterprise?
Q7: Would you be interested in implementing a quality costs control system in your enterprise?

The basic set of the research was represented by small and medium-sized businesses located in Slovakia. According to the Statistical Office of the Slovak republic 153,284 small and medium-sized enterprises were registered in 2011. Due to the large size of the basic set it was not possible to include this research with all of the small and medium enterprises, which was the reason for utilising a sampling through survey data. To choose the units from the basic set of the sample one must make a deliberate selection based on the criteria defined by the directive EK No 2003/361/EC. The intended scope of

the sample covered 300 enterprises. Determination of the scope of the sample set resulted from the following relation (Scheer, 2007):

$$n = \frac{z_{\alpha/2}^2 . p(1-p)}{\Delta_p^2}, \tag{1}$$

where n is scope of sample set, $z_{\alpha/2}$ are values of standard random quantity from (reliability specified at the level of 95%, i.e. that the value $\alpha = 0.05$ corresponds to $z = 1.96$), Δ_p is the required exactness, respectively an error of estimation (determined at 5.65%) and p is ratio (relative frequency) quality sign in the basic set (determined at 50%).

The actual scope of the sample set was at the level of 186 businesses due to the fact that 62% of the questionnaires were returned. Despite the reduced scope of the sample set the real scope of the sample set may be considered as representative. Due to the facts presented by Potkany (2011), it is possible to state that with respect to the research of institutions at the national level, the minimum scope of the sample set should be equal to 150 companies. The reduced number of the sample set influenced the error of estimation, which rose to 7.18%.

The questionnaires were distributed and also collected electronically (on-line questionnaire) after telephone conversation and agreement with the person responsible for the area of quality within the selected enterprise. The ratio of questionnaire return was 62%, which meant 136 completed questionnaires. When designing the methodology of the questionnaire evaluation it was important to take into account that the selected surveyed enterprises stood for a relatively small sample to apply statistical methods of the questionnaire survey evaluation. The questionnaire survey was evaluated by a description method, numerically and in percent's in tables and graphs. Within the questionnaire evaluation, the connections between the quality costs control and quality management were found and so the questions were evaluated either individually or in groups of narrowly coherent/related questions.

3.2. *Level of representation of the sample file*

Using the statistical testing method, the level of representation of the sample file of companies was confirmed by the application of Pearson's chi-squared test (χ^2-test), which is also known as the 'goodness-of-fit' test. The calculation of the level of representation was made at the level of a statistical significance $\alpha = 0.05$. The expected values of theoretical distribution were achieved from the Statistical Office of the Slovak Republic. The frequencies observed, and the expected (theoretical) frequencies are shown in Table 1. The degree of freedom $(k - 1)$ is equal to two, since three categories of business organisation were defined.

The achieved χ^2 value was higher than the critical χ^2 value at the level of statistical significance of $\alpha = 0.05$ for two degrees of freedom $(3 - 1)$, which in particular presents

Table 1. χ^2-Test due to enterprises' size.

	np_i (%)	n_i (%)	$(n_i - np_i)^2$	χ^2
Micro enterprises	10	9.56	0.19	0.02
Small enterprises	50	29.41	423.95	8.48
Medium enterprises	30	61.03	962.86	32.09
$\sum$				40.59

the value of 5.991 (value in statistical tables). Since $40.59 > 5.991$, the null hypothesis cannot be accepted and it cannot be stated that the sample file of companies represents their theoretical distribution.

Although according to the statistical yearbooks, the ratio of small enterprises in Slovakia is bigger than the ratio of medium size enterprises, in our research there was a dominance of middle size enterprises. It is a given fact that the subject matter of the research was to find out the level of implementation of quality costs control in enterprise practice with the present state of following the indicators of quality costs. Based on logical judgement, these levels will be higher in the case of medium-sized enterprises, and that is why this research is focused on this area.

3.3. *Analysis and discussion of results*

Based on the conducted research, it was found that 74% of the questioned enterprises do not consider management of quality and quality costs control as identical areas while 48% of those asked think that these two areas still have something in common. These two answers can be considered as correct, which means that most of the respondents have the proper knowledge of the subject matter (Figure 1).

Figure 2 represents the percentage of the answers of enterprises to question Q2 – Do you deal with monitoring individual groups of costs in terms of PAF model methodology? and question Q3 – Do you have your own methodology for costs for quality appraisal?

From the presented results we can state that enterprises, from the view of monitoring of individual groups of costs according to the PAF model, pay more attention to monitoring cost entries for external failures (67%). Our own methodology, for the purpose of cost monitoring, has only a small group of respondents (26%) and it only concerns scoring reclamations/claims. Figure 3 presents the answer structure of those enterprises which in question Q2 presented a positive viewpoint of monitoring any of groups of quality costs according to the PAF model. It can be stated that companies are dealing mostly with costs of external and internal failures that mean losses caused by poor quality (a cumulatively 65% of answers).

Question Q4 deals with personnel representation from the view of a controller of quality. Figure 4 presents the results among the surveyed enterprises which deal with quality costs control; these have mostly cumulated job functions (74% of respondents) and represent the posts of quality managers, agents for quality and managers of manufacturing. Because of this, only 4% of the surveyed enterprises have a job position of quality controller.

ISO standards are focused mostly on economic aspect of quality; there is a presumption that enterprises which have implemented the quality management system according to

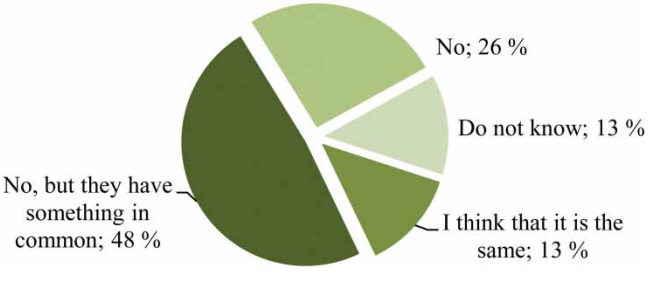

Figure 1. Q1: Do you think that quality costs control is the same as the quality management?

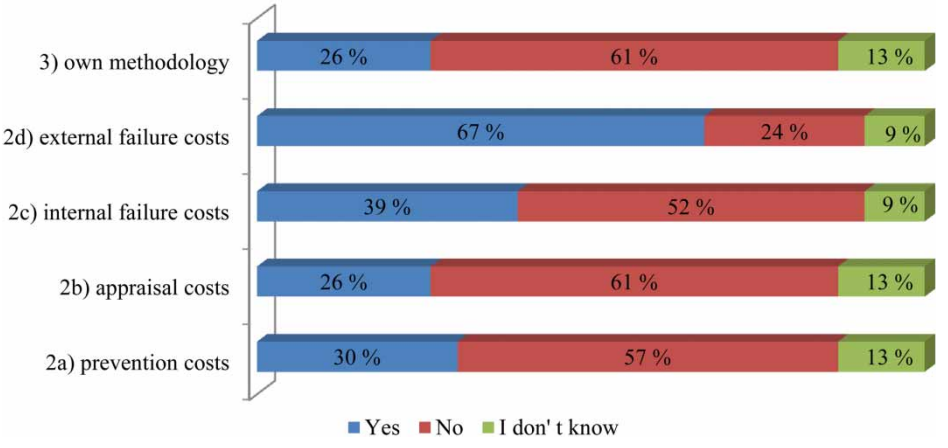

Figure 2. Questions Q2 and Q3.

ISO standards and at the same time also the process map could also in more detail deal with the economics of quality. These results are presented in Figure 5.

Figure 5 shows the following:

- The majority of respondents are certified or are undergoing the certification process according to ISO standards (57%) and another 37% are interested in certification in the future;
- also the majority of respondents have set up a process map or will prepare it in the near future (total 57%);
- referring to presented data, 65% of respondents deal with loses due to faulty manufacturing.

In the case of the question that focused on the potential of using quality costs control, it can be stated that 29% of respondents are interested in implementing a quality costs

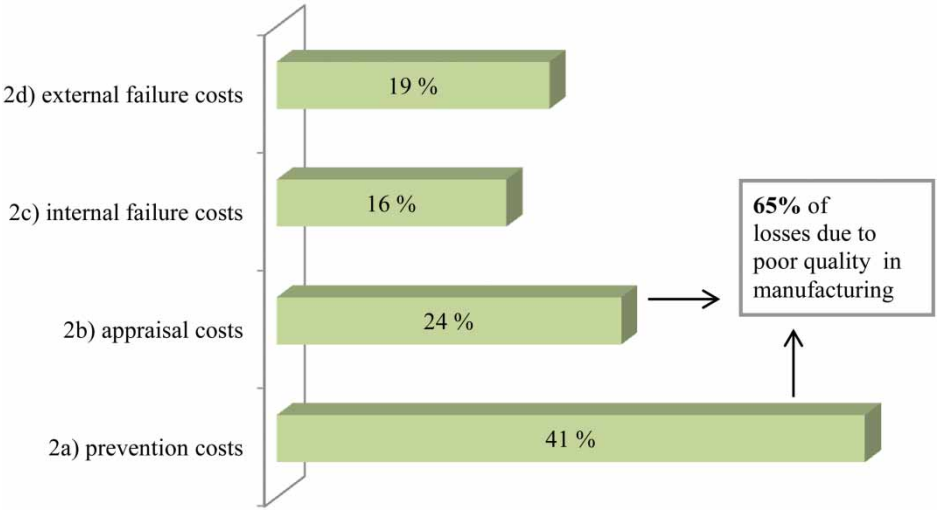

Figure 3. Percentage of individual observed groups on costs of quality.

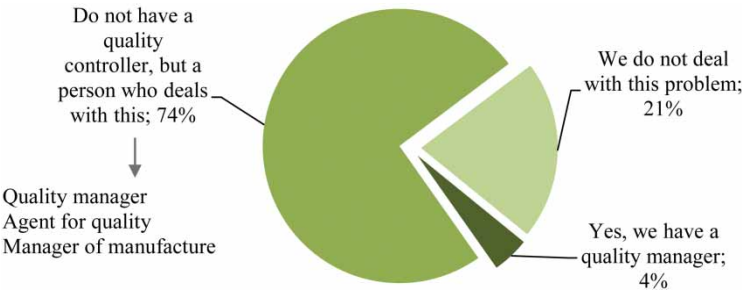

Figure 4. Q4: Do you have the position of costs of quality controller or some work position dealing with monitoring and appraisal of costs of quality in your enterprise?

control system in their enterprises, 34% stated that 'yes, but we are not sure', and the rest, 37%, did not show interest in implementing quality costs control within the enterprise at all.

The summary of the presented findings can be formulated as the results of the conducted survey: Slovak small and medium manufacturing enterprises deal mostly with costs of quality, more precisely with costs for external and internal failures (losses caused by poor quality), which means that from the view of the level of development of quality costs control, these enterprises are just in its initial phase of such development.

4. Model of the quality costs control for manufacturing with SMEs

Our model of the quality costs control for small and medium manufacturing enterprises described in Figure 6 consists of components which consider aspects of both quality of business processes and book-keeping.

For a complex understanding of quality costs control it is necessary to interconnect both areas (controlling and quality) and redefine all basic inputs of economic information. This means re-evaluation of the content of individual analytic accounts of the nominal ledger, their targeted selection, and analysis of departments in relation to quality costs.

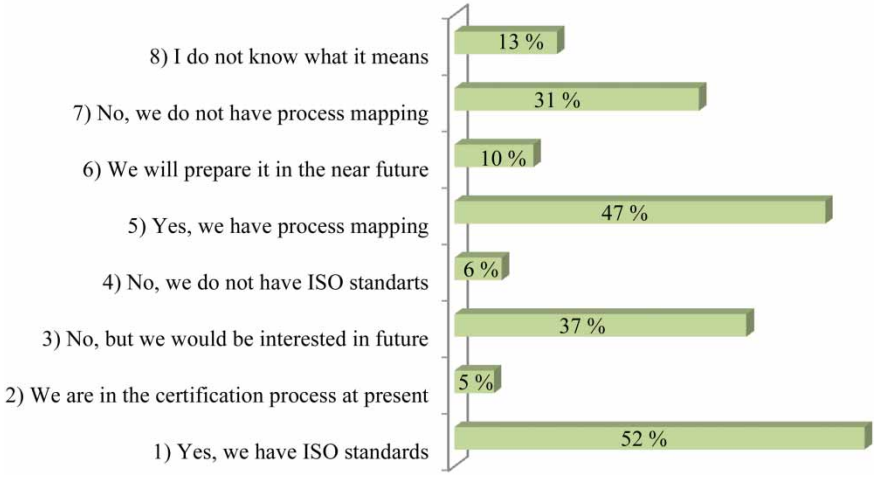

Figure 5. Questions Q5 and Q6.

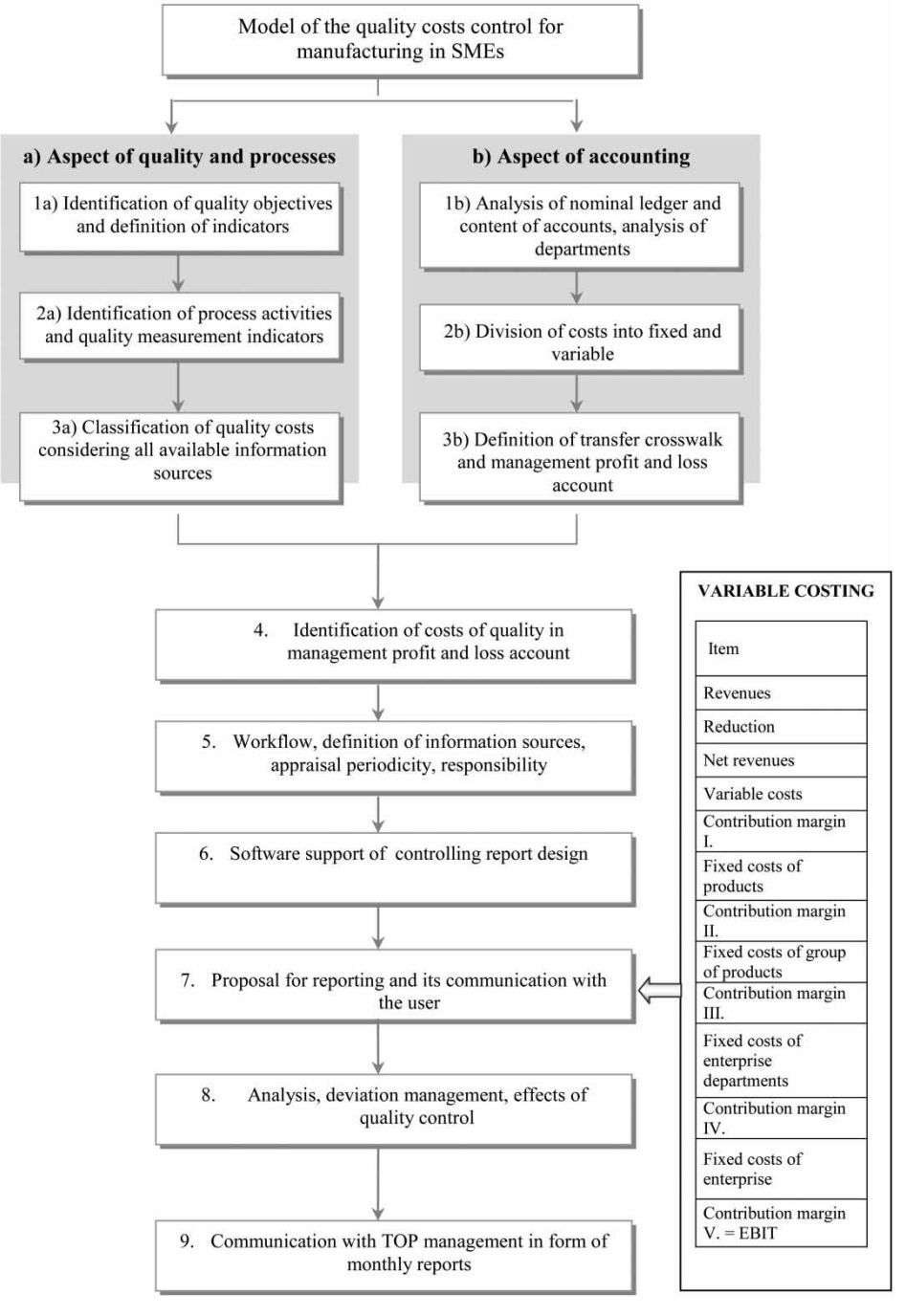

Figure 6. Model of the quality costs control for manufacturing in SMEs.

Data from the nominal ledger enters the management profit and loss account via the accounting crosswalk. The management profit and loss account is in a vertical structure based on variable costing calculation.

Management profit and loss accounts come from the methodology of gradual variable costing calculation. The enterprise costs have to be divided into fixed and variable costs.

The definition of a suitable transfer crosswalk between analytic accounts of the nominal ledger and management profit and loss accounts is considered to be an important and even an essential part of the given model. The essentials of transfer crosswalk are illustrated in Figure 6 in connection with the definition of work flow. The management of the profit and loss account is the base for monthly controlling of the appraisal of an enterprise's results. This is the starting point of a controlling appraisal and is also in the area of quality costs control. The processing of the management of the profit and loss account is proposed as a gradual classification from gross revenues via gradual adjustments of individual costs/revenues to overall economic profit before taxation (EBT). The significance of gradual variable costs calculation lies in its division of areas that can bring value to the enterprise and the areas in which the created value is spent.

For the identification of quality costs it is necessary to determine the information sources which can be utilised in the enterprise and moreover it is necessary to define particular analytical accounts and the corresponding account documents. In the case that the account documents are not sufficient, it is recommended that data from other enterprise record-keeping (reports, statistical indicators, trend analysis) also be considered.

Collection of data about costs of quality, i.e. definition of 'workflow' is considered to be most important when designing the model because it is necessary to set the approach that will be the most effective for data collection. Therefore it is a requirement to re-evaluate the content of each item of quality costs from the view of classification according to the type of costs (material, wages, energy, services, and such) and to find a way for the controller to obtain these data. i.e. how, from whom, where, and when. In this phase, it is expected to also define the code-book of individual costs of quality.

The controller obtains information about costs of quality from book-keeping and directly from delivered invoices with the identification of the department and the cost of quality according to the PAF model or the complex enterprise information software.

Information obtained this way is further evaluated via extension of the enterprise information system which is, in the proposed model represented by the controlling information system or a dynamic model in the MS Excel environment. This formulated extension of the enterprise information system makes the substance of the formation and use of an information database of our designed model in the form of a reporting message. In the proposed model of quality costs control, the quality costs (NQ) are monitored not only as absolute indicators but also as a ratio of NQ indicators, ratio of indicators to revenues, or to overall costs. At the same time it is possible to monitor variations from minimally acceptable values, their cumulative sum within the accounting period, and also in inter-annual comparisons.

The given phase deals with the design of management profit and loss accounts in its horizontal structure – to a yearly budget plan, flexible budget (FB – calculation of planned prices and costs for the real capacity of sales), reality, variances, estimates, and proposal for correction measures for the future. In a vertical structure, the controlling report is proposed in terms of a gradual calculation of variable costs and distribution into fixed and variable costs and their gradual deduction from the product price.

The costs of quality analysis should be supplemented with quality indicators through the effects of quality costs control and what can be determined. These should persuade the enterprise's managers to focus on the designed subject matter.

An important effect of quality costs control can be considered the detection of savings in costs of quality (in the area of internal errors – non-productive costs of material, energy,

work – in the area of external failures – elimination/minimising of claims and other related costs – e.g. costs of transportation and such). The external effects of quality costs control will become evident also with customers satisfaction and loyalty, in positive references, and spreading of the enterprise's good reputation, which can strengthen their competiveness in the market.

It is necessary to discuss the detected variations from the planned conditions (positive, negative) at the level of TOP management in a form of monthly controlling reports and prepare remedial measures in order to eliminate negative variances and to use the effects of positive ones.

Figure 6 presents a transparent model of quality costs control, which, from the view of versatility, is generally suitable for use in small and medium manufacturing enterprises. The model interconnects aspects of processes and the aspect of book-keeping (identification of individual analytic accounts). In the same way as the overall plan for an enterprise is made, the plan of costs in the area of quality should also be determined, which would be based on defined quality objectives (Kanapathy & Rasamanie, 2011). If it is difficult to define the scope of individual item costs, the use of their percentage setting could be suggested as follows:

- costs for external failures cannot exceed, e.g. 0.5% of revenues,
- internal failures can be, e.g. a maximum of 5% of operating costs,
- education in the area of quality from internal/external sources stated in absolute value (€).

Consequently, it is necessary within a year to compare these costs with the plan in structured reports, evaluating the variances and carrying out corresponding measures to lower the item cost.

5. Conclusion

In recent years the economic aspect of quality has come to the forefront on a larger scale. Quality is not only a technical category and the system of management of quality is not focused on product quality orientation. Quality and costs are closely interlinked. For this reason, part of the quality management system should monitor the system of costs of quality, but in many enterprises this does not work. ISO standards and the TQM approach are also devoted to process measurement and so also include the economic fundamentals of quality management (Rosenfeld, 2009).

In many enterprises, the level of internal claims and losses caused by bad-quality manufacturing which gradually cause customer dissatisfaction and the continual loss of customers is growing on a larger scale. One of the basic principles of international ISO standards is oriented to raising the satisfaction of customers. The aim of each enterprise should be the elimination of these losses, detecting weaknesses, and realisation of preventive measures, i.e. creation of an effective functioning feedback system, which would signal weaknesses on time and would offer the concerned staff valuable information for solution to the present state. These listed problems force companies to use modern management tools. Their task is to secure the quality of management by equally relevant information concerning quality with the aim of fulfiling set objectives, detecting weaknesses, and identifying process defects.

This paper analyses the current state of the subject matter based on the reviewed literature with a focus on the core of quality costs control. Via the questionnaire survey,

the level of understanding, implementation, and establishment of quality costs control was determined in Slovak manufacturing SMEs and the complex model for quality costs control suitable for small and medium manufacturing enterprises is proposed.

The essence of the introduced model is to present the sequence of steps necessary for the application of a quality control concept under conditions in small and medium manufacturing enterprises which stem from identification of quality aims, processes, costs of quality, collection of data, and definition of information sources until the final transformation into the pattern of a controlling report.

Such reports have their own horizontal and vertical structure. The vertical structure of the report is created by individual items of managing the profit and loss account beginning with revenues through gradual deduction of costs of quality until the EBT. This structure serves mainly for identification of individual costs of quality groups' identification and their appraisal through simple relative ratio indicators such as:

- relative ratio of prevention costs (P) to overall costs of quality (NQ)

$$\frac{P \times 100}{\mathrm{NQ}},$$

- relative ratio of appraisal costs (H) to overall costs of quality (NQ)

$$\frac{H \times 100}{\mathrm{NQ}},$$

- relative ratio of internal defects costs (I) to overall costs of quality (NQ)

$$\frac{I \times 100}{\mathrm{NQ}},$$

- relative ratio of external defects costs (E) to overall costs of quality (NQ)

$$\frac{E \times 100}{\mathrm{NQ}},$$

- relative ratio of internal and external defects costs (($I + E$) to overall costs of quality (NQ))

$$\frac{(I + E) \times 100}{\mathrm{NQ}},$$

- relative ratio of costs of quality (NQ) to total cost (TC)

$$\frac{\mathrm{NQ} \times 100}{\mathrm{TC}},$$

- relative ratio of costs of quality (NQ) to operation costs (OC)

$$\frac{\mathrm{NQ} \times 100}{\mathrm{OC}},$$

- relative ratio of internal and external defects costs ($I + E$) to operation costs (PC)

$$\frac{(I + E) \times 100}{\text{PC}},$$

- relative ratio of costs of quality (NQ) to gross revenue (BR)

$$\frac{\text{NQ} \times 100}{\text{BR}},$$

- relative ratio of external defects costs (E) to gross revenue (BR)

$$\frac{E \times 100}{\text{BR}}.$$

The horizontal structure of a controlling report creates two basic parameters which are time and a variant that creates the base for the so-called management system through variances. Time is given by the period of monitoring (month, quarter, and year). This version is based on the comparison of a yearly plan, flexible budget, and a real situation in the given month (e.g. May 2013–2013M05 and cumulative YTD2013M05), with comparison of the view till the end of year (E – estimate) and plan (B – budget).

The proposed model of quality costs control can be helpful for enterprises in creating a compact controlling reporting system of monitoring costs of quality and their further evaluation on the bases of controlling principles which will show the transparent flow of costs and will detect hidden reserves and enable their elimination. As small and medium enterprises show high adaptability in receiving and using progressive tools in the area of management, we can state that our proposal could be used in small and medium manufacturing enterprises.

References

Al-Dujaili, M.A.A. (2013). Study of the relation between types of the quality costs and its impact on productivity and costs: Verification in manufacturing industries. *Total Quality Management & Business Excellence, 24*(3–4), 397–419.

Branca, A.S., & Catalão-Lopes, M. (2011). Strategic interaction and quality choice. *Total Quality Management & Business Excellence, 22*(3), 265–273.

Chen, C.-C., & Yang, C.-C. (2003). Total-costs based evaluation system of supplier quality performance. *Total Quality Management & Business Excellence, 14*(3), 325–339.

Chiadamrong, N. (2003). The development of an economic quality cost model. *Total Quality Management & Business Excellence, 14*(9), 999–1014.

Eben-Chaime, M. (2013). A note on: The economic effects of quality improvements. *Total Quality Management & Business Excellence, 24*(3–4), 374–377.

Fassoula, E.D. (2005). Reverse logistics as a means of reducing the cost of quality. *Total Quality Management & Business Excellence, 16*(5), 631–643.

Freiesleben, J. (2004). On the limited value of cost of quality models. *Total Quality Management & Business Excellence, 15*(7), 959–969.

Freiesleben, J. (2005). The economic effects of quality improvement. *Total Quality Management & Business Excellence, 16*(7), 915–922.

Gavurová, B., Šoltés, M., & Balloni, A.J. (2014). Ekonomický význam využívania informačno-komunikačných technológií v systéme zdravotníctva. *Ekonomicky casopis*, *62*(1), 83–104.

Jaju, S.B., Mohanty, R.P., & Lakhe, R.R. (2009). Towards managing quality cost: A case study. *Total Quality Management & Business Excellence, 20*(10), 1075–1094.

Juran, J.M. (1988). *Juran's quality control handbook*. New York: McGraw-Hill.
Juran, J.M. (1994). The upcoming century of quality. *Quality progress, 27*(8), 29–37.
Juran, J.M. (1995). A history of managing for quality. *Quality Progress, 28*(8), 125–129.
Kajdan, V. (2007). Why quality, cost and business excellence are inseparable. *Total Quality Management & Business Excellence, 18*(1–2), 147–152.
Kanapathy, K., & Rasamanie, M. (2011). Adoption of cost of quality reporting: An initial survey of manufacturing firms in Malaysia. *2010 International proceedings of economics development and research* (Vol. 1, pp. 86–90). Kuala Lumpur: IACSIT Press. Retrieved from http://www.ipedr.com/vol1/19-B00038.pdf
Lari, A., & Asllani, A. (2013). Quality cost management support system: An effective tool for organisational performance improvement. *Total Quality Management & Business Excellence, 24*(3–4), 432–451.
Liapis, N., Theodorou, D., & Zannikos, F. (2013). Absence of TQM across the fuel supply chain: Quality failure-associated costs. *Total Quality Management & Business Excellence*, *24*(3–4), 452–461.
Lin, M.-J.J., Huang, C.H., & Chiang, I.C. (2012). Explaining trade-offs in new product development speed, cost, and quality: The case of high-tech industry in Taiwan. *Total Quality Management & Business Excellence*, *23*(9–10), 1107–1123.
Mitro, P., & Hijová, E. (2006). Myocardial contractility and cardiac filling measured by impedance cardiography in patients with nitroglycerine-induced vasovagal syncope. *Pacing and Clinical Electrophysiology: An Official Journal of the North American Society of Pacing and Electrophysiology, 29*(1), 1–8.
Mitro, P., Mudráková, K., Mičková, H., Dudáš, J., Kirsch, P., & Valočik, G. (2008). Hemodynamic parameters and heart rate variability during a tilt test in relation to gene polymorphism of renin-angiotensin and serotonin system. *PACE – Pacing and Clinical Electrophysiology, 31*(12), 1571–1580.
Omurgonulsen, M. (2009). A research on the measurement of quality costs in the Turkish food manufacturing industry. *Total Quality Management & Business Excellence, 20*(5), 547–562.
Özkan, S., & Karaibrahimoğlu, Y.Z. (2013). Activity-based costing approach in the measurement of cost of quality in SMEs: A case study. *Total Quality Management & Business Excellence, 24*(3–4), 420–431.
Pires, A.R., Cociorva, A., Saraiva, M., Novas, J.C., & Rosa, Á. (2013). Management of quality-related costs. The case of Portuguese companies. *Total Quality Management & Business Excellence, 24*(7–8), 782–796.
Potkany, M. (2011). *Outsourcing v podnikoch drevospracujúceho priemyslu na Slovensku*. Zvolen: Vydavatel'stvo TU vo Zvolene.
Rosenfeld, Y. (2009). Cost of quality versus cost of non-quality in construction: The crucial balance. *Construction Management and Economics, 27*(2), 107–117.
Sansalvador, M.E., & Brotons, J.M. (2013). Quality cost analysis: A case study of a Spanish organisation. *Total Quality Management & Business Excellence, 24*(3–4), 378–396.
Scheer, L. (2007). *Biometria*. Zvolen: Technická univerzita vo Zvolene.
Srivastava, S.K. (2008). Towards estimating cost of quality in supply chains. *Total Quality Management & Business Excellence, 19*(3), 193–208.
Su, Q., Shi, J.-H., & Lai, S.-J. (2009). Research on the trade-off relationship within quality costs: A case study. *Total Quality Management & Business Excellence, 20*(12), 1395–1405.
Tsai, W.-H., & Hsu, W. (2010). A novel hybrid model based on DEMATEL and ANP for selecting cost of quality model development. *Total Quality Management & Business Excellence, 21*(4), 439–456.
Tye, L.H., Halim, H.A., & Ramayah, T. (2011). An exploratory study on cost of quality implementation in Malaysia: The case of Penang manufacturing firms. *Total Quality Management & Business Excellence, 22*(12), 1299–1315.
Weinstein, L., Vokurka, R.J., & Graman, G.A. (2009). Costs of quality and maintenance: Improvement approaches. *Total Quality Management & Business Excellence, 20*(5), 497–507.
Wilford, S. (2007). The limits of award incentives: The (non-)relationship between awards for quality and organisational performance. *Total Quality Management & Business Excellence, 18*(3), 333–349.

Wu, L. (2010). Managing design quality and conformance quality: Models and insights. *Total Quality Management & Business Excellence, 21*(4), 383–389.
Yang, C.-C. (2008). Improving the definition and quantification of quality costs. *Total Quality Management & Business Excellence, 19*(3), 175–191.