

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

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Abstract

The paper deals with the quality costs control in small and medium-size manufacturing enterprises in Slovakia and also presents the questionnaire survey's results. An empirical study is aimed to determine the level of understanding and level of implementation of quality costs control in small and medium-size manufacturing enterprises (SMEs) in Slovakia. Research is based on PAF model. In the paper we also propose the suitable model for quality costs control in small and medium manufacturing enterprises coming from the research results. An empirical study focused on SMEs where the quality cost control often works as a latent management subsystem. SMEs managers use indicators for monitoring processes performance and production quality, but they usually do not develop a separate framework for measuring and evaluating quality costs. We ask them what extent and on what level is quality costs control used in their manufacturing small and medium enterprises in Slovakia.

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 framework design stemming from particular conditions of small and medium manufacturing enterprises practice in Slovakia. Research was carried out on the selected sample of small and medium manufacturing enterprises focusing on the current state of awareness and potential of quality costs control. The aim of the activity was to answer the basic question: „*To what extent and on what level is controlling of quality costs used in manufacturing small and medium enterprises in Slovakia?*”

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

For the purpose of collecting financial data for the research addressing the enterprises, a random sampling of 300 manufacturing small and medium enterprises was selected from various areas of national economy of the Slovak Republic. The empiric research was aimed to find out the current level of using the conditions preferably based on monitoring of specific groups of quality costs, its evaluation, and organisational security from the viewpoint of responsible controller with the use of process management. Successful use of previous conditions creates the base of the quality costs control for small and medium size manufacturing enterprises and model implementation. This model should help enterprises create a compact reporting system for monitoring the quality costs and its 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 literature review was prepared. In the second phase, a questionnaire method was used to perform an

empirical study, which represents an analysis of the situation in the solved subject matter within enterprise practice of manufacturing SMEs in Slovakia. When working on the fundamental part of the questionnaire, the model of quality cost monitoring was based on the PAF principles (prevention, appraisal, costs of failure). The questionnaire was evaluated according to graphic and description methods. In the third phase, the model of the quality costs control for small and medium manufacturing enterprises was designed. Each model generally represents reality around us. We can use models for describing economics, social or biological systems. We can also use principles for modelling of the biological systems as Mitro, P. & Hijová, E (2006) and Mitro, P., Mudráková, K, Mičková, H., Dudáš, J., Kirsch, P & Valočík, G., (2008) used for heart function.

2. Literature review

The quality costs are very closely linked to company's productivity and its performance. Al-Dujaili (2013) presents a research aiming to discover a relationship between the quality improvements, quality costs and productivity. By defying the concept of the 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, it's creating an opportunity for company's improvements. Same quality costs categories were classified in the study of Su, Shi & Lai (2009) in terms of trade-off relationship (increase of control costs resulting into decrease of failure costs and vice versa). Integrated time delays in the statistical analysis were used to compute the balanced point of the quality costs, which can provide a useful guidance on quality costs savings. Srivastava (2008) used these categories through the DMAIC (Define-Measure-Analyse-Improve-Check) methodology for quality costs analysis, to identify significant quality costs drivers, suggest measures and directions for next research. Branca & Catalão-Lopes (2011) contributed to the academic research, through updating the traditional prevention-appraisal-failure approach by the strategic reaction of other companies, which affects market shares and profits.

Analysis of costs and motivation for quality implementation were done through a survey by Tye, Halim & Ramayah (2011), who explored the assumption that implementation of quality costs helps the company to increase the quality as such, decrease the number of complaints, in line with reducing failure costs and total quality costs and improve the sales volume. Weinstein, Vokurka & Graman (2009) presented the cost of quality / cost of maintenance system as a foundation for the effective improvement and a source of information where the resources should be allocated with aim of increasing the quality and fixing the 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 of quality account matrix to calculate several types of total costs, including the share of responsibility among relevant departments.

Economic effects of the quality improvement were reviewed by Eben-Chaime (2013), who demonstrated that the decrease of production costs in order to achieve the lower quality levels is not of economic advantage (Freiesleben, 2005), but vice versa – production costs extremely increase due to low quality level. Liapis, Theodorou & Zannikos tried to estimate the costs associated with quality failures. The results stressed out the importance and the critical role of 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 optimize the process on the bases of costs minimization. Trade-off relationship between the quality costs was defined in the study by Lin, Huang & Chiang (2012) related to a new product development, showing the impact of innovation speed on project success is mediated by development cost and product quality. Traditionally design quality and conformance quality are considered separately in the literature. In the paper by Wu (2010), both quality dimensions were integrated into stylized

quality decision models for synthesizing design quality cost, conformance quality cost and product revenue components.

Measurement and estimation of quality costs appear as a critical point for company's improvement in all areas of business. Jaju, Mohanty & Lakhe (2009) have demonstrated that measuring the quality costs provides a space of quality improvements and guidelines to TQM program implementation. The relationship between conformance costs and non-conformance costs were measured by Omurgonulsen (2009). The increase of conformance costs caused the decrease the non-conformance costs, which concluded the negative relation between conformance and non-conformance costs, can rather be attributed to external failure costs than internal failure costs. Sansalvador & Brotons (2013) developed a tool to improve the company's estimation of quality costs using the fuzzy logic, taking into consideration the hidden quality costs. The final data analysis are made through the usage of both linear and possibility regression. At the other hand, Özkan & 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. Paper by Chiadamrong (2003) presented an empirical model of quality as a function of traditional costs model (prevention-appraisal-failure expenses) and hidden-opportunity quality loss costs. This approach provides us a view on tracking costs not only associated with production, however in addition to the costs associated with quality.

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

Study performed by Lari & Asllani (2013) has tied up the quality costs to operational processes and has introduced a management support system in order to help the companies to continuously measure, check and minimize the quality costs. The research, linked to the quality standards ISO 9001 and quality awards Malcolm Baldrige National Quality Award and European Foundation of Quality Management, has proved the quality cost model can be used to measure the overall performance of the companies. Fassoula (2005) addresses processes with a direct or indirect impact on quality costs, with the aim for the process oriented diagnostic tool implementation followed by assessment procedure 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 & 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 the lack of planning, control, identification and segregation of quality-related costs. Wilford (2007) investigated the relationship between gaining an award for quality and high organizational performance. Companies need to fulfil certain criteria in order to be awarded, however this award does not ensure the business excellence.

3. Empirical study in small and medium manufacturing enterprises

The aim of empirical research was to discover the level of understanding and the level of implementing 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 enterprise practice in the future. Partial aims of the research were to find out if 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 better enterprise practice quality.

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 ISO standards certificate?

Q6: Do you have a process map created in your enterprise?

Q7: Would you be interested in implementing quality costs control system in your enterprise?

The questionnaire targeted 300 significant Slovak manufacturing SMEs. The core value of the questionnaire survey would be obtained if the questionnaires would be distributed to all Slovak manufacturing SMEs (i.e. the basic outline), which though was not possible from the available time-frame and financial viewpoint. Therefore, those enterprises were addressed with the research which represents a crucial potential of the Slovak economy and so it was possible to generalise the obtained data into a basic outline.

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 % that means 136 completed questionnaires. When designing the methodology of questionnaire evaluation it was important to take into account, that the selected surveyed enterprises stand for relatively small sample to apply statistical methods of questionnaire survey evaluation. 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 out and so the questions were evaluated either individually or in groups of narrowly coherent/related questions.

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 done 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.

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	30	61.03	962.86	32.09

Σ	40.59
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The achieved χ^2 value was higher than the critical χ^2 value at the level of statistical significance $\alpha = 0.05$ for 2 degrees of freedom (3 - 1), which in particular presents the value of 5.991 (value in statistical tables). Since $40.59 > 5.991$, the null hypothesis cannot be accepted and cannot be stated that the sample file of companies represents their theoretical distribution.

Although according to statistical yearbooks, the ratio of small enterprises in Slovakia is bigger than the ratio of the medium size enterprises, in our research there was the dominance of middle size enterprises. It is given by the 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 to follow the indicators of quality costs. Based on logical judgement, these levels will be higher in the case of medium enterprises and that is why this research is focused on these enterprises.

Analysis and discussion of results

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

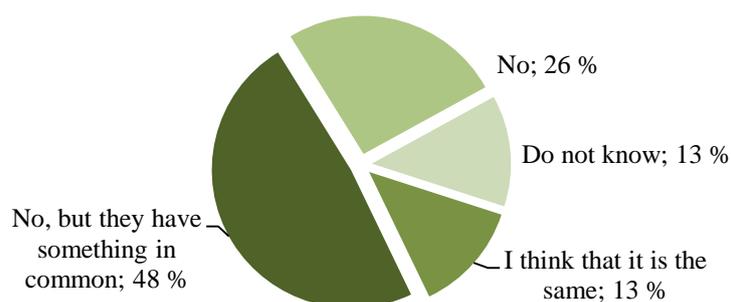


Figure 1 Q1: Do you think that quality costs control is the same as the quality management?

The following Figure 2 represents the percentage of the answers of enterprises to the 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?

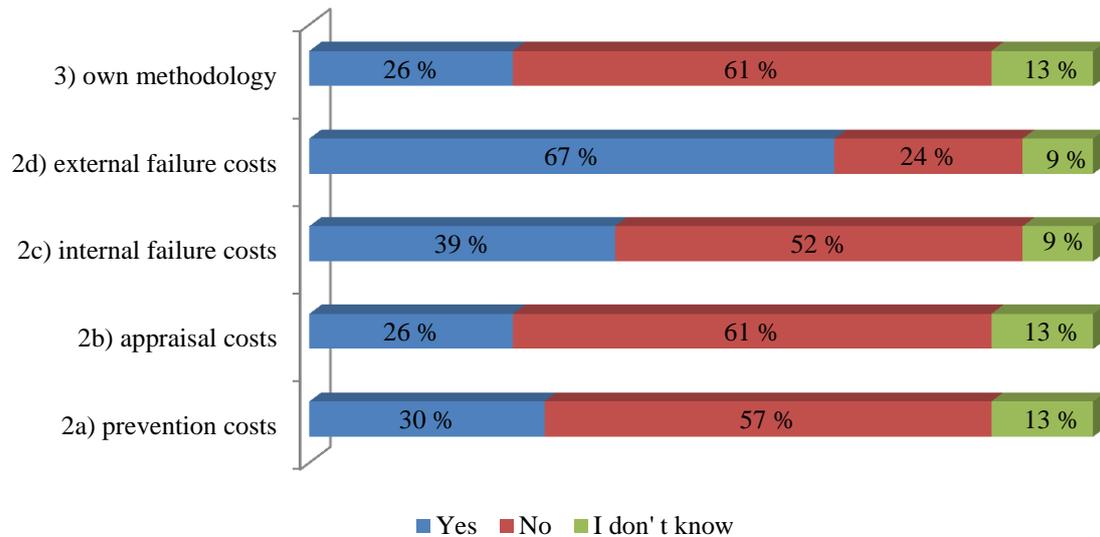


Figure 2 Questions Q2 and Q3

From the presented results we can state that enterprises from the view of monitoring of individual groups of costs according to PAF model pay bigger attention to monitoring cost entries for external failures (67%). Own methodology for the reason 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 PAF model. It can be stated that companies are dealing mostly with costs on external and internal failures that mean losses caused by poor quality (cumulatively 65% answers).

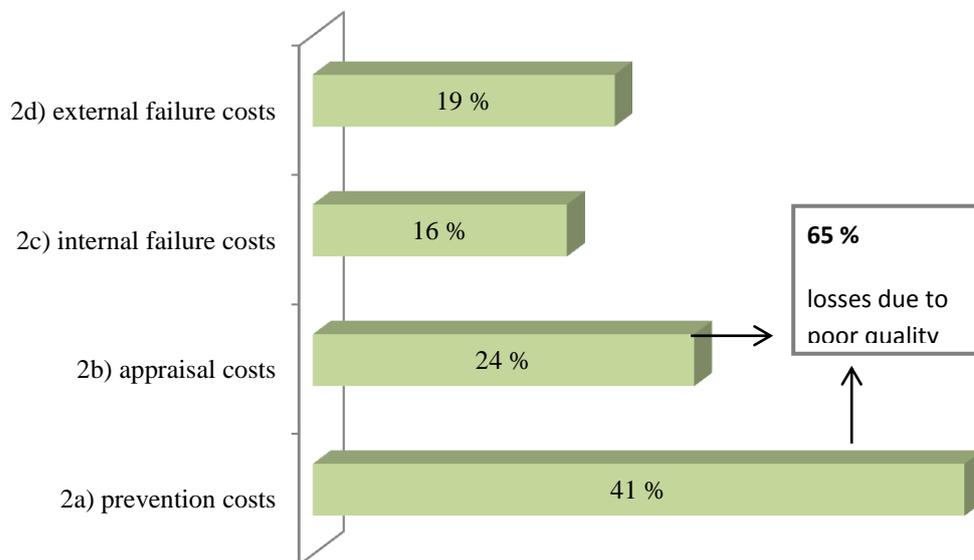


Figure 3 Percentage of individual observed groups on costs of quality

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

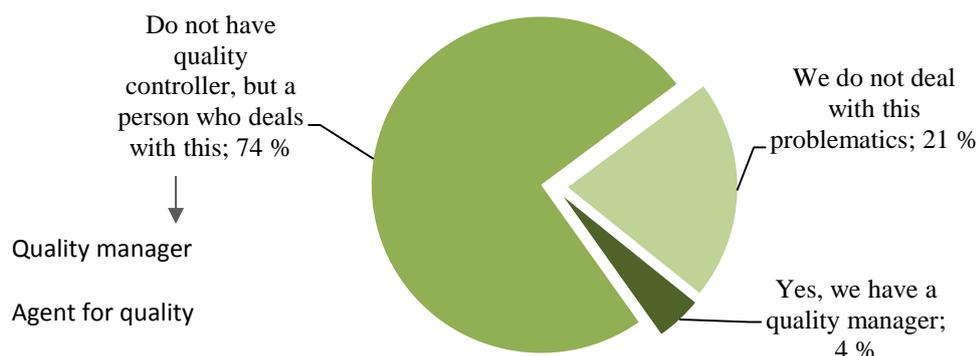


Figure 4 Q4: Do you have the position of costs of quality controller or some work position dealing with monitoring and appraisal of costs of quality in your enterprise?

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

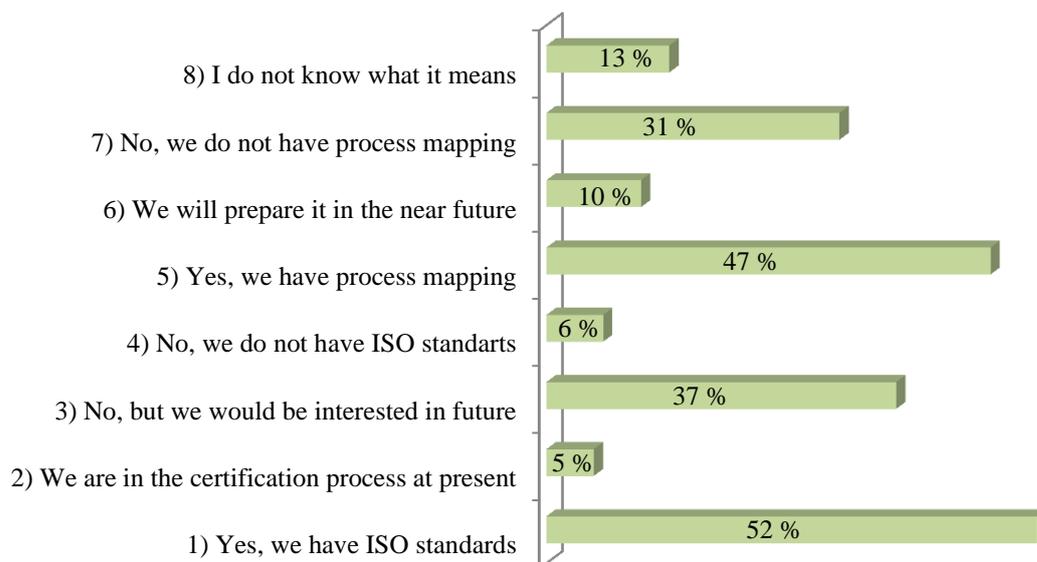


Figure 5 Questions Q5 a Q6

The Figure 5 results in the following:

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

In the case of question that focused on the potential of using quality costs control, it can be stated that 29 % of respondents are interested in implementing quality costs control system into their enterprises, 34 % stated that „yes, but we are not sure“, and the rest of 37 % did not show the 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 are these enterprises just in its initial phase of such development.

4. Model of the quality costs control for manufacturing SMEs

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

For the complex understanding of quality costs control it is necessary to interconnect both areas (controlling and quality) and redefining all basic input 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. Data from the nominal ledger will enter the management profit and loss account via the accounting crosswalk. The management profit and loss account will be in a vertical structure based on variable costing calculation.

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

Defining of suitable transfer crosswalk between analytic accounts of nominal ledger and management profit and loss account is considered to be an important and even an essential part of the given model. The essentials of transfer crosswalk are illustrated in the Figure 6 in connection with the definition of work flow. The management of profit and loss account will be the base for monthly controlling appraisal of enterprise results. This will be the starting point of controlling appraisal and this was also in the area of quality costs control. The processing of management profit and loss account was proposed in gradual classification from the gross revenues via gradual adjustments of individual costs/revenues to overall economic profit before taxation (EBT). The significance of gradual variable costs calculation lays in its division of areas that can bring to the enterprise a value 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 needed to define particular analytical accounts and corresponding account documents. In the case that some account documents are not sufficient, also data from other enterprise record-keeping (reports, statistical indicators, trend analysis) are suggested to be considered.

Collection of data about costs of quality i.e. definition of „workflow“ considered to be the most important when designing the model because it is necessary to set which approach will be the most effective for data collection. Therefore it is required 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 the way how a controller can obtain these data i.e. how, who from, where and when. In this phase, there is expected also defining code-book of individual costs of quality.

Controller obtains information about costs of quality: from bookkeeping and directly from delivered invoices with the identification of the department of the costs of quality according to PAF model or the complex enterprise information software.

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

In the given phase it deals with design of management profit and loss account in its horizontal structure to – 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 future. In vertical structure, the controlling report is proposed in terms of gradual calculation of variable costs a distribution of costs into fixed and variable 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 can be determined and these should persuade enterprise's managers to focus on designed subject matter.

As important effects 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 like). External effects of quality costs control will become evident also in customers satisfaction and loyalty, in positive references and spreading of enterprise good reputation, which can strengthen their competitiveness on the market.

Detected variations from the planned conditions (positive, negative) are necessary to be discussed on the level of TOP management in a form of monthly controlling reports and prepare remedial measures in order to eliminate negative variances and how to use the effects of the positive ones.

The following Figure 6 presents a transparent model of the quality costs control, which is from the view of versatility of its use generally suitable for small and medium manufacturing enterprises. Model interconnects the aspect 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 planned, the plan of costs in the area of quality should be also determined which would be based from defined quality objectives (Kanapathy & Rasamanie, 2011). If it is difficult to define the capacity of individual cost items, the use of their percentage setting could be suggested as:

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

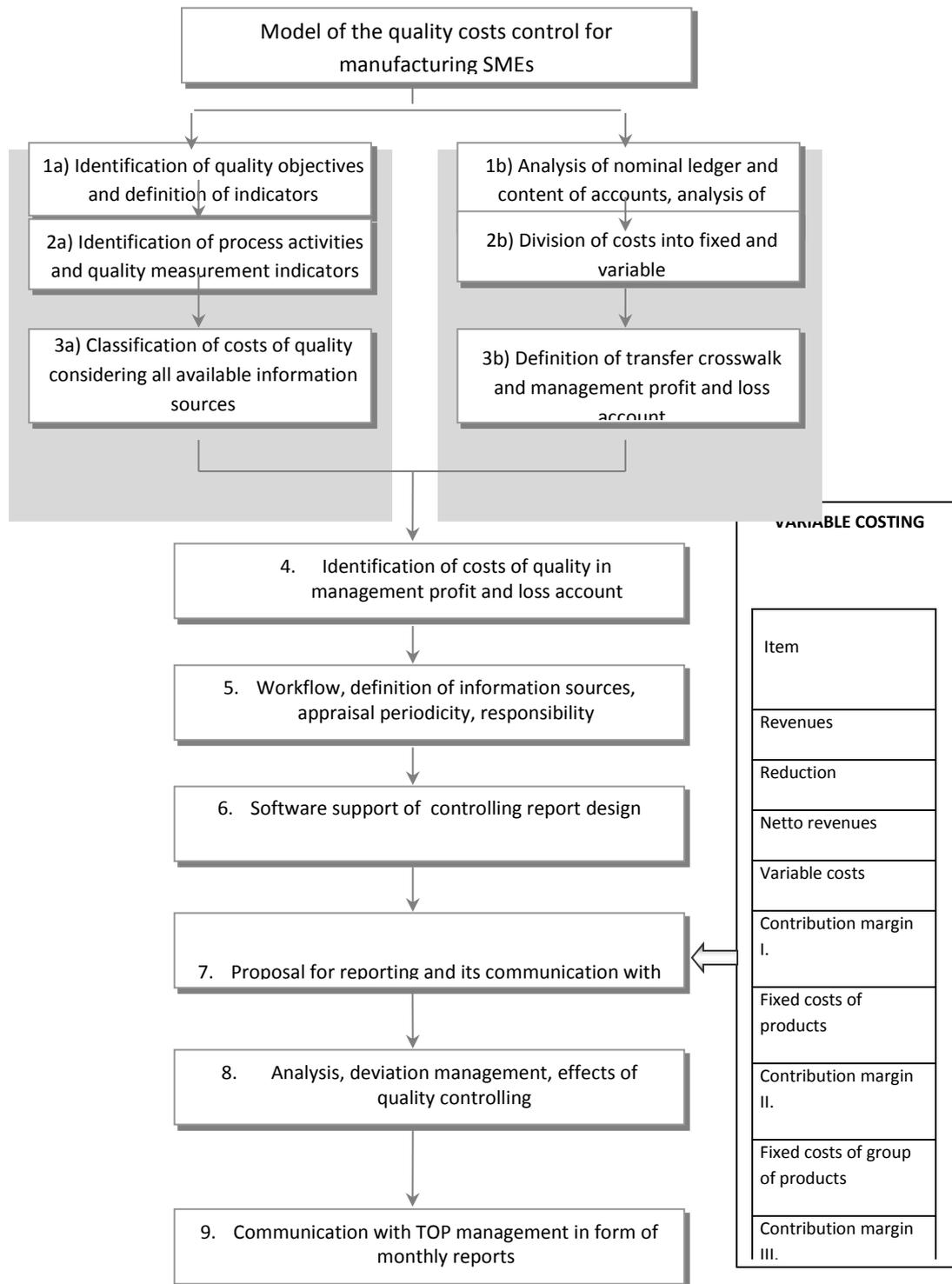


Figure 6 Model of the quality costs control for manufacturing SMEs

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

5. Conclusion

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

In many enterprises the level of internal claims and losses caused by bad quality manufacture which gradually cause customer dissatisfaction and their continual loss is growing on a larger scale. As one of the basic principle of international ISO standards is orientation on customers and raising their satisfaction, aim of each enterprise should be elimination of these losses, detecting weaknesses and realisation of preventive measures, i.e. creation of effectively functioning feedback system, which would signalise weaknesses on time and would offer the concerned staff information valuable for solution of the present state. These listed problems force companies to use modern management tools, one of which is controlling, emerging also in the area of quality management. Its task is to secure the quality management by equally relevant information concerning the quality with the aim to fulfil set objectives, detecting weaknesses and aroused process defects.

Presented paper analyses the current state of the subject matter based on the literature review with focus on core of quality costs control. Consecutively via the questionnaire survey, the level of understanding, implementation and establishing 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 was proposed.

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

Such reports have their own horizontal and vertical structure. Vertical structure of report is created by individual items of management profit and loss account beginning with revenues through gradual deduction of costs of quality until the economic profit before taxation (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)
 $(P \times 100) / NQ$
- relative ratio of appraisal costs (H) to overall costs of quality (NQ)
 $(H \times 100) / NQ$
- relative ratio of internal defects costs (I) to overall costs of quality (NQ)
 $(I \times 100) / NQ$
- relative ratio of external defects costs (E) to overall costs of quality (NQ)
 $(E \times 100) / NQ$
- relative ratio of internal and external defects costs (I+E) to overall costs of quality (NQ)
 $(I+E) \times 100 / NQ$
- relative ratio of costs of quality (NQ) to total cost (TC)
 $(NQ \times 100) / TC$
- relative ratio of costs of quality (NQ) to operation costs (OC)
 $(NQ \times 100) / OC$
- relative ratio of internal and external defects costs (I+E) to operation costs (PC)
 $(I+E) \times 100 / PC$

- relative ratio of costs of quality (NQ) to brutto revenues (BR)
(NQ ×100) / BR
- relative ratio of external defects costs (E) to brutto revenues (BR)
(E ×100) / BR

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

Proposed model of the quality costs control can be helpful for enterprises to create 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 at receiving and use of progressive tools in the area of management, we can state that our proposal could be used in small and medium manufacturing enterprises.

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