QUALITY MANAGEMENT TOOLS: ANALYSIS OF LITHUANIAN ENTERPRISES

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Abstract. The problem of quality management widely analysed in scientific literature is nowadays very relevant for Lithuanian enterprises. Article presents the analysis of various quality management models, tools and their interaction with knowledge management. A wider research is made on the classification of quality management tools introduced in the works of different authors. Quality management tools in this article are grouped according to the main stages of knowledge management: socialization, externalization, combination, internalization. There are also presented the research results of the usable quality management models and tools by the Lithuanian enterprises those had certificated quality management system. The most broadly applied quality management tools in Lithuania have been determined.

Keywords: quality management models and tools, knowledge management.

1. Introduction

Competitive ability is the main purpose of every enterprise achieved ensuring qualitative product or service for the consumer using different quality management models, methods and tools. A wide range of researches shows that yearly more and more enterprises implement total quality management principles, establish quality management systems, participate in selection for national quality awards and apply newest quality management methods. Therefore quality remains one of the main issues for nowadays enterprises.

Initial works in quality management were carried out in the second half of the twentieth century and since then quality management theory has been further developed and nurtured, new models and tools have been created, experience applying those models and tools has been analyzed. It is worth emphasizing a huge variety of quality definitions and approaches applicable to quality management – from philosophical conceptions to very particular practical methods and criteria. The conception of different hierarchical levels has been broadly applied in literature concerning quality management. Hellsten and Klefsjö (2000) distinguish three levels of quality management components: principles, techniques and tools. Lagrosen and Lagrosen (2005) also analyse three levels of quality management, however they name it a bit differently: values, models and approaches, techniques and tools.

Total Quality Management (TQM) is the most extensive conception, often understood as management philosophy and methods that prompt the organization to evolve continually, including in such process all the employees and seeking better meet the needs of consumers, improving quality of the product and reducing costs (Bendell et al. 1995; Dale et al. 1997; Hellsten, Klefsjö 2000; Hansson, Klefsjö 2003; Vanagas 2004; Vanagas, Vilkas 2008).

According to Barczyk (1999) TQM as whole consists of 18 major components. For ease of use these components according to the meaning are grouped into: substantial provisions, grand principles and management tools. The substantial provisions are the most important aspects of TQM and take in: general determination to achieve excellent quality; self-determination to satisfy the consumer; management and empowerment of participants. Five major principles are: teamwork; continuous integration of the system; creation of quality standards; quality measurement; continual quality improvement. Meanwhile Goetsch and Davis (2006) maintain that critical elements of total quality management are as follows: strategically based approach to quality; customer focus; obsession with quality; scientific approach to problem-solving; long-term commitment; teamwork; continual process improvement; education and training; freedom through control; unity of purpose; employee involvement and empowerment.

Dale et al. (1997) analysing quality management models and tools suggest using one more category – techniques. Tools are realized as the way with clear, narrow purpose and defined application, meanwhile technique is being more broadly applied than tools and its application requires more specific knowledge and experience. Sometimes technique can be defined as the collection of certain tools (Basu 2004).
It is true to say that all quality management approaches analysed in literature comprise elements of different abstraction levels and even often differently defined elements of the same level. Principles and values can be attributed to the highest (first) level, quality management approaches and models to the second level and quality management techniques and tools to the third one.

The article deals with the issue of effective application of quality management models and tools.

The purpose of this article is to analyse quality management models and tools and therefore to explore the scope of their application in Lithuanian enterprises.

2. Quality management models

There are distinguished three main and most popular approaches (or models) to quality management in scientific literature: Total Quality Management (TQM), Quality Management System (QMS) and European Foundation for Quality Management (EFQM) (Bendell et al. 1995; Dale et al. 1997; Hellsten, Klesjö 2000; Hansson, Klesjö 2003; Vanagas 2004; Vanagas, Vilkas 2008; Basu 2004; Pociūtė et al. 2004; Goetsch and Davis 2006; Kelemen 2006; Isaksson 2006; Ruževičius 2006). Total quality management (TQM) – management philosophy that prompts the continual improvement incorporating all employees into activity to raise the level of consumers’ satisfaction.

Kelemen (2006) analyses TQM conceptions and its sources, compares TQM definitions presented by different authors. She claims that the main TQM elements are: commitment of the highest authority, continual improvement through the application of scientific knowledge and incorporation of the employees. It means that scientific knowledge and application of new innovative methods are of the highest priority for TQM.

According to Kelemen (2006) it is necessary to combine elements of both „hard” and „soft” approaches analysing TQM. TQM – management philosophy which can be implemented by the planned and continual improvement, involving employees in order completely satisfy consumers’ needs. Authority commitment, continual improvement based on scientific knowledge and involvement of employees are three main elements of TQM.

Other researchers (Basu 2004, Foster 2007) describing TQM follow a “soft” approach. According to Basu (2004) TQM is based on the following principles: leadership, continual training, planning of quality improvement and cost reduction. Foster (2007) claims that the main role in theoretical quality management model goes to leadership – it is a starting point of any activity. Leaders of an organization have the possibility to manage quality assurance, involvement of employees and to form organizations culture. Quality philosophy affects leaders the way they could make decisions relative to quality strategy. Quality philosophy also helps to direct decisions towards quality assurance and involvement of employees. Leadership, quality assurance, philosophy and involvement of employees are straight directed to the consumer. From this point of view the consumer is the centre of all activities.

Quality management system (QMS) is management system coordinating actions that point and manage enterprise’s activity in pursuit of quality. Nowadays the most widely used are ISO 9000 quality management systems i.e. quality management systems that suit ISO 9001 standard’s requirements. ISO 9000 is common, conditional name of the group of international standards related to quality systems. The standards of ISO 9000 series present principles of progressive management practice based on international agreement. The main purpose of these standards is to recommend the organization a way to create effective quality management system which would prompt organizations continual improvement. Effective quality management system makes sure a long-term business success taking in all management and activity elements of the organization. The purpose

- „Soft” approach – focuses on leadership, involvement of employees and change of organizational culture. This approach was explicated by American latest scientists who particularly analysed TQM. In point of this approach the purpose of TQM is to create a strong organizational culture oriented towards consumers’ needs. To manage the object of „Soft” approach is more difficult.

- „Hard” approach – emphasizes continual improvement (CI) applying statistical methods. This approach is related to the works of the first scientists who understand the objective of TQM as the expansion of productivity and organization’s profit. It is noteworthy that the subject of “hard” approach is easier manageable.
of enterprise implementing QMS according to standards of ISO 9000 series – to arrange all proceeding processes in enterprise in order to reach better results; therefore its final product would bring the enterprise desirable profit and completely satisfy consumers needs (Basu 2004; Pociūtė et al. 2004).

The implementation of both total quality management (TQM) and quality management system (QMS) is based on common quality management principles. Some principles coincide, some do not, however the main purpose is common – to improve quality.

According to Goetsch and Davis (2006) QMS is oriented only to those processes which directly influence the quality of the product or service. Such processes are as follows: design, purchase, manufacture, installation, maintenance. It is management system designed to manage and control the enterprise seeking to reach the higher quality. QMS of an enterprise consists of quality politics, procedures, quality plans, resources, processes, empowerment and responsibilities of employees all that lead to the satisfaction of consumers. According to Kelemen (2006) QMS is like an effective communication tool which makes sure the dissemination of knowledge. Combining both definitions we may draw the conclusion that TQM as quality management model is oriented to the outside of enterprise and open to various knowledge and innovations; QMS is narrower tool which could be used to manage information and knowledge inside the enterprise. Consequently both models attempt to improve quality through information and knowledge, at one point orienting to the information and knowledge existing outside the enterprise, in other case – to the flows of information and knowledge inside it.

The business excellence model (EFQM) – it is a model to estimate the perfection level of business and is often called self-assessment model. It prompts the creation and implementation of quality improvement initiatives in all activities of enterprises.

The popularization of Total Quality Management philosophy has been particularly influenced by the world-class awards (W. E. Deming Prize (Japan), Malcolm Baldrige National Quality Award (United States)), ISO 9000 international standards and EFQM model in Europe which was the basis creating National Quality Prizes of European countries (Basu 2004). World-class, national awards and EFQM model have contributed to the popularization of other quality management models. Analysis of awards’ multiple elements shows that E. Deming Prize requirements do not take into consideration the basic principles of TQM, but analysing EFQM model this orientation is conspicuous. Also comparing elements of each model major coherence is conspicuous between Malcolm Baldrige National Award and EFQM model and this shows that implementation of TQM principles has been pursued gradually ever since. It is important to note that both world-class awards and EFQM model are used to evaluate enterprise’s activity improving quality or implementing TQM principles. Lithuania also sticks to the same approach honouring enterprises with National Quality Prize Award. Enterprises seeking for such award are valuated using criteria prepared in accordance with EFQM model (Ruževičius 2008).

Besides TQM, QMS and EFQM several other quality management models are analysed in literature (Basu 2004; Foster 2007): Six Sigma, Lean Production, Lean Sigma and Fit Sigma. Six Sigma and Lean Production nowadays are the most popular models among world-class industrial enterprises which combine a lot of different tools. There are presented two approaches in the literature which describe Lean Production. The first is philosophical waste reduction approach. According to the proponents of this approach everything that does not create added value in the process must be eliminated. The second one is systematic approach. As an example of this approach is production system of Toyota Motor Company. Combining these two approaches Lean system can be defined as a framework designed to optimize the processes through the philosophy of continual improvement.

More than just a few new tools have been created based on Lean Production Toyota original model. Lean Production consists of eight tools: Total productive maintenance (TPM); Five S; Just-in-time; Single minute exchange of dies (SMED); Judoka or Zero quality control; Production work cells; Kanban; Poka yoke.

Concept of Six Sigma became popular in 1985 when its initiator Bill Smith again included statistical methods into TQM philosophy. The main features which differentiate Six Sigma methodology from TQM are as follows:

- Emphasis of measurement and statistical methods;
- Strictly structured training system (Champion, Master Black Belt, Black Belt and Green Belt);
- Application of Project-focused approach using a unified problem-solving tool DMAIC (define, measure, analyse, improve, control);
- Reinforcement of the leadership, continual training and planning principles.
The results of accomplished literature analysis reveal that the main quality management models selected for the further research in Lithuanian enterprises are: TQM, ISO 9001, EFQM, Six Sigma, Lean Production and Lithuanian National Quality Award.

3. Classification of quality management tools

The scientific literature contains various classifications of quality management tools. Basu (2004) centralizes quality tools according to Six Sigma elements (DMAIC). Adomėnas (2000) and Foster (2007) quality management tools group into qualitative and quantitative. Barczyk (1999) distinguishes ten quality management tools: research of models; training; perception of the processes as whole (orientation to the processes); determination of the problems; problem solving; sponsorship of employees’ quality; active management; sponsorship of suppliers’ quality; communication; appreciation and motivation of employees. American Quality Association (2009) presents grouping of quality management tools in accordance with its nature of use. For example: tools to collect data, analyse processes, create ideas and so on. The above-mentioned authors identify overall 64 different quality management tools in their classifications. It should be noted that general list of total quality management tools includes models with different levels of quality management components, such as quality management system in accordance with ISO 9001 international standard, EFQM business excellence model, Design of Six Sigma (DFSS), although some of them could be mentioned as quality management models or simply as a self-assessment models. Some authors (Basu 2004, Foster 2007) include well-known management methods (SWOT analysis, PESTLE analysis, balanced development) and project management tools (Gantt chart, network, project management) to the list of quality management tools. To be more specific 42 of all 64 quality management tools have been mentioned in just one source (American Quality Association, 2009), 22 tools – in two and only 13 tools have been analysed in at least three sources.

The authors of the article propose to group quality management tools in accordance with the stages of knowledge management using Nonaka and Takeuchi model (Fig. 1) and considering the main condition used for the grouping: change of knowledge format (tacit, explicit) through a variety of quality management tools.

Accomplished analysis shows that 13 quality management tools mentioned in at least three references in accordance with knowledge management stages could be ranked the following way (Table 1):

− Externalization stage (tacit knowledge becomes explicit) – 6 tools;
− Combination stage (explicit knowledge becomes explicit) – 6 tools;
− Internationalization stage (explicit knowledge becomes tacit) – 1 tool.

Socialization stage does not take into account any tools as knowledge changes only by content but does not change the form and remains tacit or, in other words, knowledge evolve only at individual’s level. Most quality management tools can be attributed to the externalization and combination stages, where knowledge changes both content and form.

Quality management tools can be also analysed by another knowledge management aspect – knowledge formation. As scientists analysing knowledge management state first of all data are formed or received at the level of the individual or company afterwards it turns into information and finally knowledge is formed (Kimiz 2005; Probst et al. 2006; Pollard, Šimerová 2006; Šimerová 2007; Davidavičienė 2008; Martišius, Martišius 2008; Young, 2008; Šedžuvienė, Vveihart 2009). In order to achieve a higher quality, improve quality of products or services quality has to be measured. One way to measure quality is using a direct expert measurement with points. Another option to measure product’s quality is using hierarchical system of quality indicators (Pabedinskaite, Vitkauskas 2009) and multicriteria evaluation methods (Ginevičius, Podvezko 2005; Ginevičius 2007a; Ginevičius 2007b; Ginevičius, Krivka 2009, Elskytė, Zinkevičiūtė 2008; Raudeliūnienė, Elskytė 2008; Zavadskas et al. 2001). In this case
quality indicators would be understood only as data at the initial stage which directly processed could be turned into information and which requires to be turned into knowledge in further stages of activity. Quality management indicators could be understood as the lowest category of quality management elements in the system, where quality management tools and models belong to the higher category. Therefore analysing quality indicators through quality management tools, individual’s (or enterprise’s) knowledge about the product’s quality would be finally formed.

4. The results of researches of Lithuanian enterprises

The purpose of the research – to determine to what extent quality management principles, models and tools are applied by Lithuanian enterprises and evaluate the efficiency of quality management models. Efficiency evaluation is made using seven points system (1 point – very bad, 7 points – very good). Evaluating the implementation of quality management principles seven points system is also used (1 point – very narrow, 7 points – very broadly).

Respondents participated in the research were employees of Lithuanian enterprises which produce products of various metals and have implemented quality management system in accordance with requirements of ISO 9001 international standard. Total number of such enterprises presented by Lithuanian Standardization Department is 59. 34 manufacturing enterprises took part in the mentioned research and most of them were attributed to the small and medium size enterprises (23.5 % of enterprises workforce contained 11–50 employees; 64.7 % – workforce contained 51–250 employees; 5.9 % – workforce contained 251–500 employees; 5.9% – workforce contained 501 and more employees).

The research was made using prepared questionnaire and grouped quality management principles, models and tools as follows:

**Principles:** Customer orientation; Process orientation; Leadership; Employee involvement; Continual learning; Continual improvement; Measurement and monitoring of activities (Management by facts).

**Models:** ISO 9001, Lithuanian National Quality Award, EFQM business excellence model, Six Sigma model, Lean Production model.

**Tools:** Failure mode and effects analysis; Cause-and-effect diagram; Flowchart; Design of experiments; Brainstorming; Affinity diagram; Benchmarking; Pareto diagram; Relations diagram; Histogram; Scatter diagram; Check sheet; Control chart.

Table 1. Classification of management tools by knowledge management stages

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The same quality management tools which have been mentioned by at least three (of five) authors have been chosen to the research since it demonstrates the coincidence of views due to importance of quality management tools in quality management process (Table 1). The research aimed to evaluate how enterprise’s employees responsible for quality management system estimate the functioning efficiency of quality management system as a model, do they measure products’ quality indicators.

Hence, researches results show that all enterprises participated in the research apply requirements of ISO 9001 standard and do not apply any other model.

Answering the question due to effective application of quality management models (Fig. 2) 12 % of enterprises pointed that quality management models function good (6 points), 41 % pointed that quality management models function good enough (5 points).

![Fig. 2. Evaluation of Efficiency of quality management model](image)

![Average value of quality management principles (Fig. 3) implementation extent is 5.31: the top evaluation was referred to Custom orientation principle – 6.29, the lowest evaluation to Leadership principle – 4.18. This shows that not all main quality management principles are broadly implemented.](image)

Research results show that three knowledge management stages (externalization, combination and internalization) are implemented in quality management process applying particular quality management tools. Evaluating the application of all quality management tools in general 28 % of enterprises claim that quality management models function well and indicate that apply quality management tools (Fig. 5).

![Fig. 5. Implementation of quality management tools and indicators in Lithuanian enterprises](image)

Therefore 65 % of respondents count products quality indicators. The most broadly counted products quality indicators are as follows: term of guarantee allotment comparing with analogues; quantity of the products that served without defects all the period of guarantee. Enterprises
with have evaluated quality management model function good enough count products quality indicators more often then others (correlation coefficient among the number of enterprises' efficiency evaluations and enterprises which evaluate quality criteria $r = 0.93$ and is significant – $t=5.62 > t_{0.01} = 2.57$).

Following the research results we can claim that quality management system’s efficiency mostly depends on the use of particular quality indicators of the product and quality management tools.

5. Conclusions

Classification of quality management principles, models and tools is relevant quality management issue. Following the classifications of different authors there is presented (offered) the classification of quality management tools in accordance with knowledge management stages: socialization, externalization, combination, internalization). Most of the quality management tools are attributed to the externalization (tacit knowledge transforms into explicit knowledge) and knowledge combination stages.

The research results show that all enterprises that took part in the research implement quality management model according to ISO 9001 international standard and do not pretend to Lithuanian National Quality Award or implement new quality management models. The representatives of Lithuanian enterprises estimate the efficiency of their applied quality management models very good. The most popular quality management tools used in enterprises are as follow: control chart (70.6%); check sheet (52.9%); failure mode and effects analysis (41.2%); cause-and-effect diagram and brainstorming method (23.5%).

References


