
CONTINUAL IMPROVEMENT WITHIN THE QUALITY MANAGEMENT SYSTEMS

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1 INTRODUCTION

Continual improvement is an important principle of total quality management and also new quality management principle involved to the revised ISO 9000 family of standards, which were officially released on 15th December 2000. It is an important part of the achievement and keeping of organization competitiveness and should be a permanent objective of the organization. Practical experience show that many companies are going out of business simply because they are not able to improve as quickly as their competitors.

According to the definition continual improvement is recurring activity to increase the ability to fulfil requirements. Its base is quality improvement, which is defined as part of quality management, focused on increasing the ability to fulfil quality requirements (ISO/FDIS 9000, 2000).

Improvement activities are very similar to the problem solving activities. The main difference is that improvement activities are planned and usually organized as part of larger program, whilst problem solving is usually more reactive and unplanned.

2 CONTINUAL IMPROVEMENT IN THE ISO 9000 FAMILY OF STANDARDS

The principle of continual improvement underlies in the lots of requirements and recommendations of the ISO 9000 family of standards. Let us introduce some of them.

- The organization shall establish, document, implement and maintain quality management system and continually improve its effectiveness in accordance with the requirements of the international standard. The organization shall:

- Identify the processes needed for quality management system and their application throughout the organization
 - Determine the sequence and interaction of these processes
 - Determine the criteria and methods needed that both the operation and control of these processes are effective
 - Ensure the availability of the resources and information necessary to support the operation and monitoring of these processes
 - Monitor, measure and analyse these processes
 - Implement actions necessary to achieve planned results and continual improvement of these processes (ISO/FDIS 9001, 2000, clause 4.1)
- The organization shall continually improve the effectiveness of the quality management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and management review (ISO/FDIS 9001, 2000, clause 8.5.1).
 - Continual improvement requires management support. Top management shall provide evidence of its commitment to the development and implementation of the quality management system and continually improving its effectiveness. Continual improvement of the effectiveness of the quality management system must be included in the quality policy. Also management review which must be carried out at planned intervals must include the assessment of opportunities for improvement and the need for changes to the quality management system, including quality policy and quality objectives (ISO/FDIS 9001, 2000, clauses 5.1, 5.3, 5.6.1).
 - As to requirements to the process „Measurement, analysis and improvement” organization shall plan and implement the monitoring, measurement, analysis and improvement processes needed to demonstrate conformity of the product, to ensure conformity of the quality management system, and to continually improve the effectiveness of the quality management system. This shall include determination of applicable methods, including statistical techniques, and the extent of their use (ISO/FDIS 9001, 2000, clause 8.1).
 - Management should continually seek to improve the effectiveness and efficiency of the processes of the organization, rather than wait for a problem to reveal opportunities for improvement. Improvements can range from small-step ongoing continual improvement to strategic breakthrough improvement projects. The organization should have a process in place to identify and manage improvement activities (ISO/FDIS 9004, 2000, clause 8.5.1).

2.1 Process for continual improvement

Process for continual improvement, which should be used in organization, is described in the annex of ISO/FDIS 9004 standard (ISO/FDIS 9004, 2000). Continual improvement process should involve following steps:

- a) Reason for improvement: a process problem should be identified and an area for improvement selected, noting the reason for working on it.
- b) Current situation: the effectiveness and efficiency of the existing process should be evaluated. Data to discover what types of problems occur most often should be collected and analysed. A specific problem should be selected and an objective for improvement should be set.
- c) Analysis: the root causes of the problem should be identified and verified.
- d) Identification of possible solutions: alternative solutions should be explored. The best solution should be selected and implemented: i.e. the one that will eliminate the root causes of the problem and prevent the problem from recurring.
- e) Evaluation of effects: it should then be confirmed that the problem and its root causes have been eliminated or their effects decreased, that the solution has worked, and the objective for improvement has been met.
- f) Implementation and standardization of the new solution: the old process should be replaced with the improved process, thereby preventing the problem and its root causes from recurring.
- g) Evaluation of the effectiveness and efficiency of the process with the improvement action completed: the effectiveness and efficiency of the improvement project should be evaluated and consideration should be given for using its solution elsewhere in the organization.

Given continual improvement process is in detail developed Deming cycle PDCA (Plan – Do – Check – Act). Even though continual improvement process description is very brief, detailed analysis shows that individual steps are practically the same as the steps of the known Quality Journal method (Kume, 1988; Nenadál et al.; Plura, 1998, 1999) (see Table 1). Some differences are only in the second and seventh steps where the evaluations of the effectiveness and efficiency of existing and improved processes are emphasized.

3 WV MODEL OF CONTINUAL IMPROVEMENT

As aid to understanding of continual improvement the WV model is used (Shiba et al., 1993) (see Fig. 1). This model regards improvement process as problem-solving process and distinguishes three types of improvement: process control, reactive improvement and proactive improvement. It also conveys the idea of moving systematically back and forth between abstract thought and empirical data during the process of solving a problem. For instance to sense a problem and then collect data on where it might be, to choose a specific improvement activity and

then collect data on exactly what is wrong and to plan a solution and then collect data to be sure it works and then standardize the new solution. This process fully correspond to another basic quality management principle “Factual approach to decision making”. Implicit in the WV model is the idea of iterative improvement – the cycling back to work on the next problem or to continued improvement of an already improved process.

Table 1 *The comparison of the steps of continual improvement process described in ISO/FDIS 9004 standard with Quality Journal Method*

Deming cycle	ISO/FDIS 9004:2000	Quality Journal
Plan (P)	Reason for improvement	Problem identification
	Current situation	Problem monitoring
	Analysis	Analysis of the problem causes
Do (D)	Identification of possible solutions	Design and realization of measures to eliminate causes
Check (C)	Evaluation of effects	Measures efficiency evaluation
Act (A)	Implementation and standardization of the new solution	Permanent elimination of causes
	Evaluation of the effectiveness and efficiency of the process with the improvement action completed	Report about problem solving procedure and future activity planning

Process control is based on the monitoring the process to make sure that it is working as intended e.g. by using control chart. If the process produces results that are out of its control limits, the worker takes correction, which eliminates the defect in the process. This cycle is assigned as SDCA cycle (Have a **S**tandard – Use/**D**o standard – Evaluate/**C**heck effects – **A**ct to return to standard). Process control is not proper improvement, because its result is that process comes back to the standard.

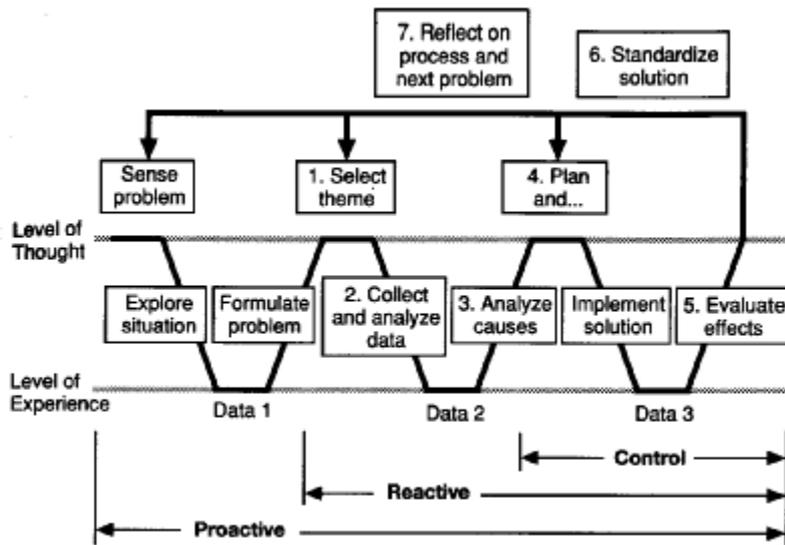


Figure 1 WV model of continual improvement (Shiba et al.,1993)

Reactive improvement is focused to the improvement of a weak process. It follows when a level of the process outputs is insufficient and workers corrections of the process according to the process manual are not efficient. In the case of the reactive improvement it is necessary to collect data, analyse them, find the root causes of the problem and implement appropriate countermeasures. The quality improvement methodology e.g. Quality Journal Method is used for this case (see Table 1).

Proactive improvement deals with situations in which companies choose a direction of an improvement activity. At first it is only general awareness that something is a problem (sense problem). After it the situation is broadly explored and problem is formulated. Next steps can usually continue in accordance with the steps of the reactive improvement. Proactive improvement activities involve preventive actions, which eliminate the causes of potential non-conformities in order to prevent their occurrence. However they are understood much wider, because furthermore they involve many of other activities, which are a part of quality planning.

4 BREAKTHROUGH IMPROVEMENT AND INCREMENTAL IMPROVEMENT

They are two fundamental ways to conduct continual improvement: breakthrough improvement and incremental improvement. These ways are essential for two approaches to the improvement, which are called as Reengineering and Kaizen. These two ways are also introduced in the ISO/FDIS 9004 (ISO/FDIS 9004, 2000):

- a) breakthrough projects which either lead to revision and improvement of existing processes or the implementation of new processes; these are usually carried out by cross-functional teams outside routine operations,
- b) small-step ongoing improvement activities conducted within existing processes by people.

Optimum results can be achieved by the suitable joining of the both approaches. As example of this a comparison of the Japanese TQM approach and Western approach to the improvement can be introduced (see Fig. 2) (Shiba et al.,1993). Japanese TQM approach was characterized by the using of both breakthrough improvement and incremental improvement, western approach (U.S. approach) was characterised by the using of breakthrough improvement only. As shown in the Fig. 2, if the two approaches start at the same level over time the Japanese approach results in a significant advantage.

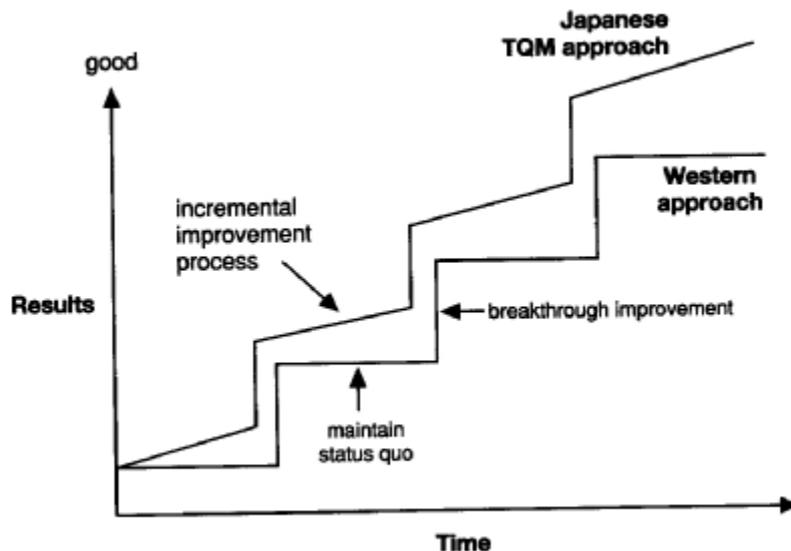


Figure 2 The comparison of Japanese TQM approach with Western approach to the improvement process (Shiba et al.,1993)

Optimum ratio of the application of these two approaches depends on the concrete situation and on the organization level. Reengineering approach is suitable especially for organizations lagging behind (if they are able to make it from financial point of view), while Kaizen approach is suitable when organizations are on the enhanced level (Zgodavová, 1998).

The course of the curves in Fig. 2 indicates that in case of using incremental improvement only the results will be worse than in case of using breakthrough improvement only. In the other work (Leach, 1996) is contradicted that implementing many small changes can add up to create a greater overall effect

than implementing a single large change. This statement is probably based on the calculation only, where the overall effect of 100 1% improvements is compared with the effect of one 100% improvement, but it is possible to agree with the statement that most organizations are easily able to adapt many of 1% changes then one radical 100% change.

5 SUITABLE METHODS AND TOOLS FOR CONTINUAL IMPROVEMENT

The success and effectiveness of the continual improvement activities can be considerably increased by using of suitable methods and tools. The analysis of the suitability of selected basic methods and tools in the individual phases of continual improvement was performed with using of matrix diagram (Plura, 1999, 2000) (see Fig. 3). These methods and tools which are especially suitable for using in the individual phases are highlighted. Detailed description of selected methods can be found e.g. in the works (Plura, 1997, 1998a, Nenadál et al., 1998).

6 CONCLUSIONS

In the connection with the release of revised ISO 9000 family of standards the organizations must implement continual improvement principle to their quality management systems. Submitted paper deals with basic aspects of this task; with continual improvement process, ways of its realization and with suitable methods and tools.

The paper extent does not make possible to deal with all aspects in some detail. However, it results to the conclusion that organizations must build up suitable conditions for continual improvement implementation. The very important part of these conditions is people training in both continual improvement methodology and suitable methods and tools applications.

PHASE TOOL	Reason for improvement	Current situation	Analysis	Identification of possible solutions	Evaluation of effects	Implementation and standardization ...	Evaluation of the effectiveness ...
Affinity diagram	AA		A	AA			A
Interrelationship diagram	AA		A	A			A
Systematic diagram	AA		A	A			A
Matrix diagram	A	A	A	A		AA	A
Matrix data analysis	A	A		A	A		A
PDPC diagram	AA			AA		A	A
Arrow diagram	A			A			A
Quality Function Deployment	A	A	A	A			A
Failure Mode and Effect Analysis	A		AA	AA	A		A
Fault Tree Analysis	A		AA	A	A		A
Design of Experiments			AA	AA	A		A
Process Capability Evaluation	A	AA	A	A	A	A	A
Machine Capability Evaluation	A	AA	A	A	A		A
Gage Capability Evaluation	A	AA	A		A		A
Flow Chart	AA	A		A		AA	A
Cause and Effect Diagram			AA		A		A
Data Collection Form		AA	AA	A	A	A	A
Pareto Diagram	AA	A	AA		A		A
Histogram	A	AA	A		A	A	A
Scatter diagram	A		AA		A		A
Control Chart	AA	AA	A	A	A	A	A

Figure 3 Matrix diagram of the selected methods and tools suitability in the individual phases of continual improvement

AA – Tool is especially suitable for use in the given phase

A - Tool is suitable for use in the given phase

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