# IMPLEMENTATION OF A CONTINUOUS IMPROVEMENT PROCESS WITHIN AN AUTOMOTIVE PLASTIC INJECTION MOLDING ORGANIZATION

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**Rezumat.** *Lucrarea abordează structura procesului de îmbunătățire continuă și implementarea unui sistem de control, analiză și corecție pentru toate incidentele înregistrate în organizație ca neconformități. Rezultatele obținute prin testarea fiecărei metode analizate evidențiază următoarele acțiuni: reducerea costurilor legate de non-calitate prin analizarea și eliminarea cauzelor neconformității; creșterea productivității prin optimizarea continuă a proceselor, activităților și resurselor alocate; îmbunătățirea satisfacției clienților și creșterea competitivității, cultură organizațională matură, rezultate orientate către client și competitive; instruirea continuă a angajaților; alinierea la standardele de calitate actuale.*

**Abstract.** *The paper addresses the structure of the continuous improvement process and the implementation of a control, analysis, and correction system for all incidents recorded in the organization as nonconformities. The results obtained by testing each method analysed, highlight the following actions: reducing the costs of non-quality by analysing and eliminating the causes of non-compliance; increasing productivity through continuous optimization of processes, activities and allocated resources; improving customer satisfaction and increased competitiveness, mature organizational culture, customer-oriented and competitive results; continuous training of employees; alignment to the actual quality standards.*

**Keywords:** Plastics; identification, root causes analysis. nonconformity, organization performance

## 1. Introduction

Plastics injection is a manufacturing process of parts, obtained by injecting molten granules into a mold. The melt cools and by solidification takes the form of the cavity in which it was injected.

In recent years, products made of plastic have grown due to the high productivity of the process, the versatility and potential to replace metal in many applications.

Plastic appeared as raw material at the end of the IX century (ebonite and celluloid). The technology developed slowly until the middle of the XX century

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when it began to grow. In 1944 the worldwide production of polymer resins, being used mainly in electrical applications, for insulation. The main groups of materials used today, Polystyrene, Polyvinyl chloride, Polyolefins and polymethacrylates, were developed at industrial level before 1950.

Plastics injection is a manufacturing process of the parts, obtained Since the middle of the XX century, the development of plastics has taken a large scale, they penetrating into the majority of industries. Plastics injection is used to produce goods such as packaging, auto parts and components, toys, storage containers, mechanical parts, components of medical installations and appliances, in electronics, consumer goods, and even military applications.

The use of plastics in the automotive industry, the development of which has driven the development of the entire world economy, has led to lower vehicle mass, increased active and passive safety, lower fuel consumption and emissions, and major aesthetic improvements allowing due to flexible technology shortening the development time of new models.

Achieving a high level of quality is a desideratum of all companies in the automotive industry being one of the fundamental conditions to remain on the market. The drop in quality costs is also very important because it is linked to the overall decrease in costs and thus to the increase in competitiveness.

The automotive industry is also highly competitive. End-customer requirements are constantly increasing and automakers are struggling to attract customers through ever better offers materialized by reasonable prices, high-level product characteristics and the quality that the customer perceives through the reliability manifested by the vehicle and the degree to which he feels satisfied with the characteristics of the products.

In this context, the continuous improvement activity has a central place in any company in the automotive industry, its objectives being the permanent improvement of the product quality and the general results of the activity measured in the end by profitability and market.

## 2. Complexity of work

In a company that has as main activity the production of plastic parts by injection, there are many activities in many fields, grouped by processes. Customers require products that meet the technical requirements and have the required quality, low prices and short delivery times.

The company wants to meet customer requirements in terms of profitability, being interested in increasing sales and lowering costs.

In this sea of complexity there are always opportunities for both positive, performance improvement and negative results, defective products, malfunctions in activities.

Defects can have different causes that need to be identified and eliminated by specific actions.

Dysfunctionalities can lead to unjustified stationary of machinery and equipment or activities, or they can be directly fault-generating.

Before the occurrence of defects and malfunctions, preventive actions can be taken to reduce damage due to defects and stationery.

Also, any factual situation, expressed by indicators such as: the number of defects, the percentage of defective parts, the degree of loading of machines, the degree of availability of machinery, the rate of achievement of preventive maintenance, the ratio between preventive maintenance and corrective maintenance, the time of change of manufacture, etc.– can be improved. More than domestic expectations, cost reduction requirements also arise and so the need for continuous improvements becomes mandatory because competition in the field is constantly increasing and customer requirements are also increasing.

In this context, the continuous improvement activity is positioned as a central mechanism for improving performance in a company, through specific actions aimed at preventing defects and malfunctions, quickly and permanently correcting defects and malfunctions, finding solutions to improve the situation and collecting and applying employee improvement ideas.

## 3. Description of how to approach the improvement system through analysis

An important role in quality management system processes is the process of continuous improvement that has as objectives

- achieving customer satisfaction;
- continuous improvement of the quality of products and services;
- improve the effectiveness and efficiency of processes throughout the organization;
- the reduction of losses due to poor quality.

Improvement opportunities are marked by customer feedback, internal and external audit results, and non-quality analyses, and the conclusions of the measurement and monitoring of processes.

To identify opportunities for improvement, the following steps are followed:

- proving the need for improvement by identifying non-conformities;
- analysis and diagnosis of the causes of nonconformities;

- implementation of improvement actions

- application of improved working standards so that results are always applicable and measurable;

- transversal of the measures identified to all processes and products with transversal potential;

- measuring the effectiveness of the actions taken;

- use of lessons learned at the organization level.

The working methods established to identify improvement opportunities and action measures are:

a) QRQC (Quick Response Quality Control) - is a tool that allows effective problem solving, based on a cross-cutting working group, which works according to all criteria of quality technical analysis and is led through the continuous improvement department.
b) „The implementation of QRQC within plastics manufacturing companies has led to significant improvement in the efficiency of the production process by identifying and quickly solving quality problems, which reduced downtime and increased customer satisfaction" [1].

## 4. Component elements of internal processes and the interaction between them for continuous improvement

For the implementation of the quality management system, the organization has identified a series of processes that are designed to manage internal activities.

A process is an organized set of interacting activities to create a result expressed in a product or service with added value. A process describes in detail the course of activities that are carried out inside it, designed in time and highlights a method of operation with the purpose of producing a specified result.

In the organization are established 18 processes structured on three types, according to the process map:

- management processes

- main processes

- support processes

Interaction between processes is an approach based on the connection of activities, through the input data and output data, respectively, by obtaining customer-oriented results.

## 5. Key success factors

Continuous improvement is a sure way to increase the competitiveness of companies. A company that does not rely on continuous improvement can only achieve success temporarily, followed by the degradation of results over time.

Key success factors for implementing a continuous improvement system that is a solid basis for improving results are (Fig. 1):

- commitment of the organization management at all levels;

- changing the organizational culture to determine an appropriate organizational behavior that can perpetuate indefinitely the efforts of continuous improvement;

- the involvement of all employees in the continuous improvement efforts;

- implementation of a simple but rigorous analysis system and integration of all departments in efforts to identify solutions;

- implementing a rigorous system to track how actions are implemented and the results obtained from this implementation;

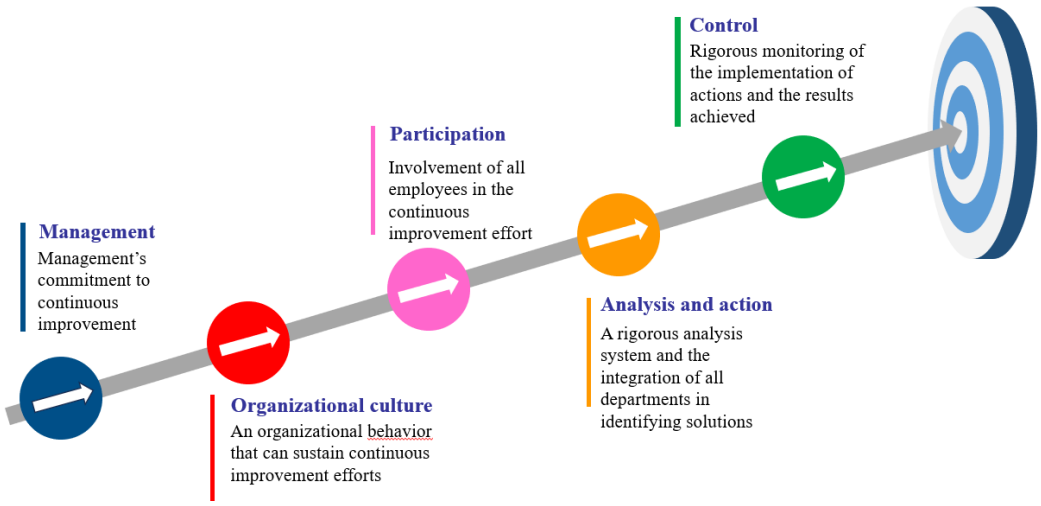


**Fig.1.** Key success factors

„The successful implementation of Kaizen practices depends significantly on the commitment and involvement of senior management, which must create a favorable environment for continuous improvement and support change initiatives at all levels of the organization" [2].

## 6. Areas of continuous improvement

A modern continuous improvement system is characterized today by 3 important areas:

- maintaining current performance,

- continuous improvement in small steps,

- innovation.

The context in which the automotive industry is currently operating has begun to put ever-increasing pressure on costs. Legislation at European level is becoming increasingly restrictive in terms of pollutant emissions, which has led to increased production costs due to the introduction of additional technical elements to help neutralize harmful emissions or streamline combustion processes.

The increase in costs for car manufacturers has led to a significant increase in the price of products for end customers, which could not be accepted by them and would have resulted in a decrease in sales volume.

As a result, automakers have been conveying cost pressure in the horizontal industry at all levels, which has meant reducing their margins and jeopardizing the very functioning of horizontal industry firms.

In an attempt to adapt, the horizontal industry has started work efficiency programs. This is also the case for plastic injection companies whose management has considered that the solution is to focus on activities related to continuous improvement, in order to improve operational performance and reduce costs.

Industry trends overlapped the health crisis and the economic crisis of 2020 and 2021, which still have effects today.

## 7. Exploratory phase and initial parameters

In this phase, all new and old problems are reviewed, which are manifested at the operational level and a statement is adopted at the top management level on the will to solve non-conformities in order to reduce costs and the intention to put the work of continuous improvement first.

*The initial parameters are:*

- the general level of costs per factory

- the coefficient of waste on the factory

- number of quality incidents with the customer

- OEE

- share of standstill times due to defects in machines and molds.

## 8. The basic assumptions

The first important assumption concerns the demand for products and services that risk falling as customers select companies that have a solid system of improvement as partners, focused on reducing losses and reducing costs, providing innovative working solutions and technologies (Fig. 2).

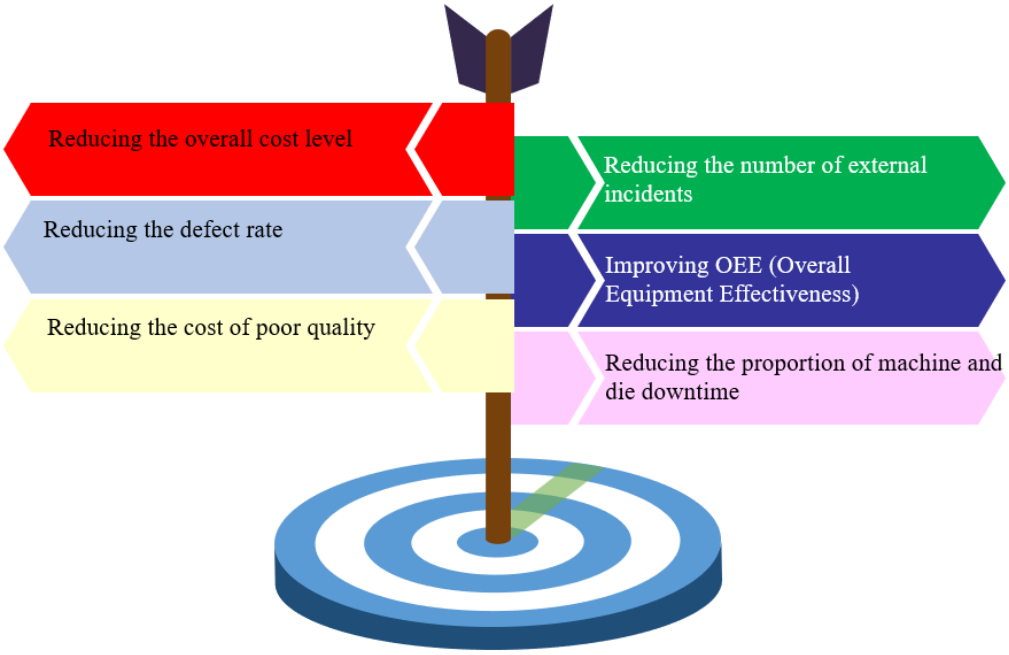


**Fig. 2.** Management objectives

One of the first findings concerns the inability of the system to reduce the number of external incidents to a reasonable level which could lead to serious image loss, high costs from customer incidents and even loss of ISO and IATF certifications [4, 5].

## 9. Implementation QRQC and QRQC-S

In order to achieve the level of performance outlined by the organization, it was decided to implement the system of analysis of nonconformities through the QRQC system and the following important decisions were taken [7-9]:

- abandoning the approach of methods of analysis on the problem of the day model, the synthesis of the day and the method of dealing with all problems

- addressing all issues in the QRQC process by addressing all issues focused on complex analysis of causes

- daily conduct of QRQC analyzes, with the participation of all persons involved in the process and through the direct involvement of department heads

- involvement of top management in the analysis action to contribute to the process support effort

*Quick Response Quality Control – Systemic (QRQC-S)*

The implementation of QRQC in manufacturing processes allows rapid identification of defects, promoting continuous improvement and ensuring quality consistency throughout production" [3, 6].

QRQC-S represents the abbreviation" Quick Response Quality Control - Systemic" and is the activity of responding to nonconformities analyzed in QRQC and classified by areas of nonconformities.

The introduction of QRQC-S was made as a result of the finding that certain types of defects occur with a certain frequency, which led to the conclusion that there may be causes in the internal environment that are favorable to the occurrence of these problems and that, as long as these causes are not identified and treated, the number of problems will not decrease or will decrease very hard. The introduction of the QRQC-S is a continuous improvement approach at a higher level because it took place after the development of the QRQC system and after obtaining very good results. The supply of the QRQC-S system is carried out according to the classification of the analyzed areas in the QRQC analysis phase.

This means that each analyzed QRQC is assigned a disseminated domain according to the causes of occurrence.

Each QRQC analysis is based on a generic cause interpreted by the standard methodology of the 5M (machine, material method, work hand, environment). QRQC-S undoes these 5M factors into another 100 factors it calls wide „domain". A generic domain list has been built, created based on the analysis and causes recorded in QRQC. Each cause of machine, material, method, labor, environment, is assigned several domains that are related to the analyzed cause.

The difference between QRQC and QRQC-S lies in the level of application and the complexity of the approach:

- QRQC (Quick Response Quality Control) focuses on the rapid resolution of quality issues at the operational level (e.g., production line), through immediate reactions and short-term corrective actions.
- QRQCS (Quick Response Quality Control Systemic) extends this concept to a system level, aiming not only to fix issues quickly but also to identify root

causes, standardize solutions, and prevent recurrence across the entire organization.

In short, QRQC = fast local reaction, while QRQC-S = systemic, preventive, and integrated approach. QRQC-S goes beyond the immediate, localized reaction of basic QRQC by addressing issues at a systemic level (Table 1).

**Table 1.** QRQC versus QRQC-S comparison

| Differences between QRQC and QRQC-S | |
|---|---|
| **QRQC** | **QRQC-S** |
| Fast focus. The objective is to obtain a quick response | Slow focus, broad process. The objective is to obtain a response with lasting effects |
| Focus on product, process | Focus on the organization |
| Preventive and corrective actions at the level of root causes | Preventive and corrective actions at the organizational level |
| Limited preventive actions, focused on a specific subject | Preventive actions focused on a broader scope |
| Focus on quality improvement | Focus on organizational improvement |
| Approach based on the 5M tool | Analytical approach based on multiple analysis tools |
| Standard analysis method | Analytical concept |
| Selective involvement of management, through escalation in decision-making on actions | Full involvement of management |
| Implementation of actions at product, process level | Implementation of actions at factory, organization, group, or other interested entities level |

## Conclusions

The application of QRQC-S (Quick Response Quality Control Systemic) in the plastic injection industry enables a shift from simple rapid reactions to a structured and preventive quality management approach. By extending actions beyond the machine level or isolated defects, QRQC-S supports the identification of root causes (e.g., process parameters, raw materials, mold wear), the standardization of solutions, and the replication of best practices across all production lines.

In conclusion, implementing QRQC-S leads to a reduction in recurring defects, improved process stability in injection moulding, increased operational efficiency, and enhanced overall product quality at the organizational level.

The main goal of the research was to identify a working system to analyse the causes of nonconformities in the plastic injection process. Due to the diversity of products and services carried out within plastic injection companies, the non-conformities that occur vary depending on each area of activity, such as production, quality, logistics, maintenance or even human resources [10-12].

Two of the main challenges of applying the working system were:

1) create an effective communication flow between processes so that non-conformities are properly reported and analysed in a coordinated way to ensure correct identification of root causes and not just treatment of symptoms.

2) implementing a well-structured change plan that will face resistance to new from employees or teams.

The choice of nonconformity analysis system in the plastic injection industry contributes significantly to improving the performance of the organization. By both theoretical and practical nature of the tools used in the process of continuous improvement, applied through the analysis of nonconformities, an efficient production, a high-quality level and a high degree of customer stasis are obtained.

The results obtained by testing each method analysed, highlight the following actions:

- Reducing the costs of non-quality by analysing and eliminating the causes of non-compliance
- Increasing productivity through continuous optimization of processes, activities and allocated resources
- Improving customer satisfaction and increased competitiveness, mature organizational culture, customer-oriented and competitive results
- Continuous training of employees
- Alignment to the actual quality standards.

**Future research directions:**

- Further explore the synergy between QRQC and QRQC-S and evaluate the results obtained in various industrial contexts;
- Deepening the relationship between QRQC, QRQC-S, and the LLC system, as well as analyzing how their integration can contribute to improving organizational performance.

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